The WELDING ENGINEER

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(See Page 29)

July
1934
Vol. XIX No. 7

...neer Business and Technical Journal of the Welding Industry

"Don't tell me, Lad, they're putting the knee-action idea into welding machines."

"No, Pop, but you would think so if you welded with the 'Shield-Arc.' It levels out the peaks and valleys in the welding current."

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MEMBER AUDIT BUREAU OF CIRCULATIONS

THE WELDING ENGINEER

LEADING ARTICLES IN THIS ISSUE

JULY 1934

Vol. 19, No. 7

NRA MEMBER U.S. WE DO OUR PART

Reinforced-Concrete Pipe (Page 15)
Building Reinforcing Cages for Colorado River Aqueduct (Coyle)

Boulder Dam (Page 17)
Welding on the Boulder Dam Cylinder Gates and Nose Liners (Jennings)

Largest Welded Bridge (Page 23)
Details of Design and Construction of the World's Largest Welded Bridge (Leonhardt)

Stainless-Steel Railway Car (Page 26)
The Welded Car Enters the Local Transportation Field

Editorial—(Page 13)

Kenneth Burton Mackenzie—(Page 16)

Get "H. O. T." on Welding—(Page 22)

Bridge Roadway With Welded Plates (Johnston)—(Page 25)

Welding News in Pictures—(Page 28)

Welding in Observatory Dome and Building—(Page 29)

New Equipment—(Page 30)

Trade Literature—(Page 31)

Commercial News—(Page 32)

Notes From the Field—(Page 32)

Published on the 15th of each month by The Welding Engineer Publishing Company, 608 S. Dearborn St., Chicago, Ill. Telephone Webster 7134.

G. H. Mackenzie, *President and Treasurer* K. B. Mackenzie, *Secretary* F. L. Spangler, *Editor*

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PACIFIC COAST: W. R. McIntyre, 1115 Tyler St., Glendale, Calif.

Subscription, payable in advance: United States and possessions, $3 a year; Foreign Countries, $4 a year; Canada, $4 a year; Single copy, domestic, 25 cents; Single copy, foreign, 30 cents. Entered as second-class matter January 20, 1916, at the postoffice at Chicago, Illinois, under the act of March 3, 1879.

FOREIGN REPRESENTATIVES: GREAT BRITAIN—Capt. D Richardson, 26 Winterbrook Road, Herne Hill, London; AUSTRALIA and NEW ZEALAND—R. Hill, Matlock House, Davenport, Auckland, New Zealand; SOUTH AFRICA—J. W. Arnison, 35a Victoria Avenue, Benoni, Transvaal, South Africa.

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This stream-lining eliminates turbulence, lowers operating pressures and produces sharp welding flames that weld faster, because the heat is *all* directed where it is needed—into the weld zone.

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★★ No weight handicap.—The handle is *solid, tubeless* and contains *no soldered joints* nor screws. It is made of drawn and forged Duralumin, having one third the weight of brass and greater strength than mild steel. That is why the GX is the Universal Torch, because it covers the entire limits of the process —*and carries no handicap weight.*

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INDEX TO ADVERTISERS

	PAGE
A	
Aladdin Rod & Flux Mfg. Co.	34
American Brass Co., The	33
American Steel & Wire Co.	7
Anti-Borax Compound Co.	38
B	
Bastian-Blessing Company, The	6
C	
Carter-Lockard Co.	35
Central Steel & Wire Co.	Inside R. C.
Champion Rivet Co.	38
Churchward Engineering Co.	38
Commercial Acetylene Supply Co., Inc.	35
F	
Fibre-Metal Products Co.	35
G	
General Electric Co.	8-9
H	
Harnischfeger Corporation	11
Hobart Bros.	3
I	
Ideal Face Shield Co., The	34
Illinois Steel Co.	Rear Cover
Imperial Brass Mfg. Co.	
International Nickel Co., Inc., The	
L	
Lincoln Electric Co., The	Inside F. C.
M	
Metal Bond Manufacturing Co.	
Milburn Co., The Alexander	
N	
National Carbide Sales Corp.	
R	
Resisto-Loy Co.	
Revere Copper & Brass, Inc.	
Roebling, John A., Sons Co.	
S	
Safety Gas Lighter Co.	
Seneca Wire & Mfg. Co.	
Shawinigan Products Corp.	
Steel Sales Corp.	
Stoody Co.	Inside R. C.
Stulz-Sickles Co.	
T	
Torchweld Equipment Co.	

· E D I T O R I A L ·

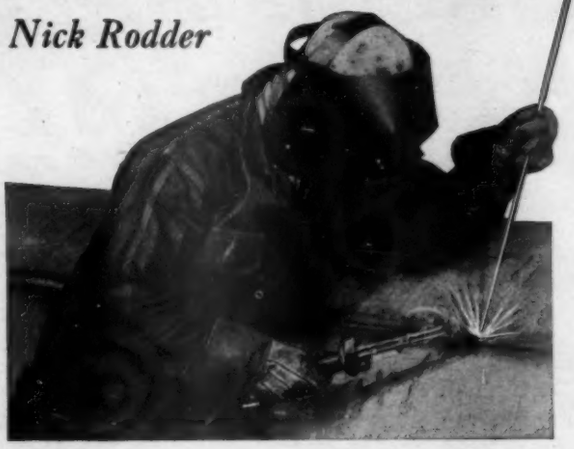
LET GOOD ARCHITECTURE SELL STEEL HOUSES

The steel house is coming into its own, but it will not have "arrived" until it can claim its own peculiar style of architecture. As long as the present differential exists between the price of steel and of lumber or other material, the steel house can't be sold on a purely cost basis. Advantages claimed for steel, of stability, long life, fire resistance, and proof against vermin, are obvious, but they are not apt to carry much weight with the home buyer except where such important factors as cost and appearance are somewhere near equal in the choice between steel and other materials. ¶ There are three possibilities by which more steel might be put into houses: (1) build standardized houses on a production basis whereby unit costs will become so low that they can compete with other materials on a cost basis; (2) in the conventional house, substitute steel for wood in columns, floor beams, and wherever its obvious advantages will balance the increased cost; (3) create a demand for a type of architecture which is more readily adapted to steel construction than to other materials. The second suggestion is, no doubt, entirely workable, but the other two suggestions have the advantage, from the standpoint of the steel maker and distributor, that if steel can be substituted for other materials in wall and floor panels, the potential tonnage would be several times that resulting from the use of steel for main structural members only. ¶ While some day steel houses, standardized and made on a production basis, might be produced and erected as cheaply as houses of wood or other materials, no one has yet been able to do it. In fact, there is good reason to believe that steel will always have to overcome the competitive disadvantage of first cost. Of the factors that influence an individual or a family in selecting the type of home, the most important, aside from cost, are comfort and appearance. As regards comfort, the steel house doesn't have to give way to any material. Properly constructed, it is the very acme in comfort, whether air-conditioned or not. But brick, tile or wooden houses can also be very comfortable. ¶ Then there is the factor of attractiveness that the steel-house builder can use as a lure to the prospective home owner. It happens, however, that some monstrosities have been committed in the name of architecture by builders of steel houses. Such misshapen fancies of builders' minds are the result of a lack of esthetic sense; blame for them should not be laid at the door of steel, which in itself is not an ugly material and can be made beautiful by good taste in use and proportioning of lines. Houses have been built of steel framing and steel wall panels that are very pleasing to the eye and have attracted the attention of the public who have seen them, which goes to prove that steel architecture can be made attractive, even when applied to dwellings. ¶ If such architecture is to sell steel, however, it must be more adaptable to steel than to any other material. It would seem that steel could easily compete with any other material in the case of a permanent structure having a flat roof and rounded corners. Gables and sharp corners, therefore, might conceivably be absent in the new steel architecture. Just as the gable type of house was a natural outgrowth of the effort to save in the use of wooden framing, so also the new architecture would be one that makes most efficient use of the structural advantages of steel, and, with a demand created for this style of house, a great many of the public would be willing to pay an increased price, if not beyond reason, to live in the new style which is becoming to modern ways and which befits the "modernistic" lines in present-day furniture and decorations. ¶ The immediate problem of the designer and builder, therefore, would seem to be the development of an individualistic architecture fitted to steel construction, so planned as to design, fabrication and erection that costs will not be beyond what the home buyer will pay for the privilege and satisfaction of living in the new style. ¶ While few houses are being built today, regardless of material used, this condition can't go on forever. In fact, reliable data show that in many sections of the country, conditions are creating a shortage of single-family dwellings that will be keenly felt before many more months. Therefore, it isn't too early for the home builder and architect to do some serious planning along the line of steel design, with the view toward building permanent steel homes that will be an asset to their communities. Since costs must be watched carefully, particularly in the beginning of such a program, the possibilities of welded design will necessarily receive much attention and full use will be made of the economic advantages of welding.

AN ADVERTISEMENT FOR NICKEL-BEARING WELDING RODS MANUFACTURED BY THE INTERNATIONAL NICKEL COMPANY

"I Cover The Welding Front"

By Nick Rodder



THIS new rush of dispensing, winery and distilling equipment is keeping me busier than a one-eyed man in the Streets of Paris.

Last week, for instance, I'm shot over to Chicago to straighten out a shop that had a rush order for some "beverage dispensers".

Ten of them were pure Nickel, and one, by way of trial was made of Inconel.

The welder at the shop was up in the air. He knew how to handle the straight nickel job, but the Inconel (Chrome Nickel alloy) had him stumped. Said the flow of metal was "sluggish".

Well, I got him off in a corner and we went into action. We set up two pieces of Inconel scrap and welded them, using a definitely reducing flame, with a feather about ¼" long. After the joint cooled, he bent it through 90° one way, then 90° the other. His eyes nearly popped out.

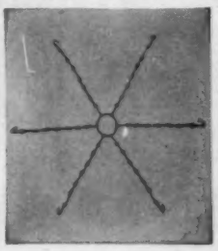
He'd been using too high a heat and too sharp a flame. Didn't give the metal time to flow together, but after he tried his own hand at it he got the hang of it. It was just a case of using a softer flame with a good feather on it, together with a simple jig that made the job a cinch. When I left, the welder slipped me a cigar his brother-in-law had given him. He'd been saving it for Sunday, but said he wanted *me* to have it!

I've been called in on all sorts of jobs, from changing a tire for the Boss' wife to attending the wake of a deceased customer. But one of the most ticklish assignments I've had handed me was to help a textile machinery manufacturer weld Monel Metal kier chain to replace steel chain formerly used. Of course, the steel rusted and stained the goods.

Chain was a little out of my line, up to then. But after all it was a welding job and up to me. When I landed at the plant it wasn't much different from any other Monel Metal welding job.

The links were formed from 7/16" hot rolled Monel, with an eye at either end. At the center of the link there is only a single cross section of 7/16" rod.

The acetylene man was an old hand, but even he was a little jittery, and inclined to give her too much temperature. We cut down the heat, that stopped overheating and burning the metal. Inside of an hour we were turning out Monel Metal chain that would have held a battleship.



☼ ☼ ☼

The boss has just handed me a telegram to hop on the Pennsy flyer and go to Harrisburg on some good sized Nickel-Clad Steel hoppers. If I get back in time, I'll tell you about it next issue. Until then, keep me in mind if you run into any tough situation that threatens to stump your regular crew. Working together, we'll straighten it out.

As ever,

Nick Rodder

INCO WELDING SERVICE

INCO WELDING RODS and FLUXES

for **PURE NICKEL**

Oxy-Acetylene . . . "T" Nickel Gas Welding Wire.
Metallic Arc . . . INCO Nickel Metallic Arc Welding Wire No. 31.
Carbon Arc . . . INCO Nickel Carbon Arc Welding Wire No. 21.

for **MONEL METAL**

*Oxy-Acetylene . . . Monel Gas Welding Wire.
Metallic Arc . . . INCO Monel Metal Arc Welding Wire No. 30.
Carbon Arc . . . INCO Monel Carbon Arc Welding Wire No. 20.

for **INCONEL**

**Oxy-Acetylene . . . Inconel Gas Welding Wire.
Metallic Arc . . . Inconel Metallic Arc Welding Wire No. 32.

for **NICKEL-CLAD STEEL**
(for welding of Nickel side)

Oxy-Acetylene . . . "T" Nickel Gas Welding Wire.
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FLUXES

Use *INCO Gas Welding and Brazing Flux for Monel Metal.
** "Cromalloy" Gas Welding Flux is recommended for Inconel. (Mfd. by Oxweld Acetylene Co.)
No flux is used for the gas welding of Pure Nickel or Nickel-Clad Steel.

•

INCO welding materials as listed can most conveniently be obtained through regular INCO distributors.
Detailed welding instructions furnished on request.

THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL STREET, NEW YORK, N. Y.

The Welding Engineer

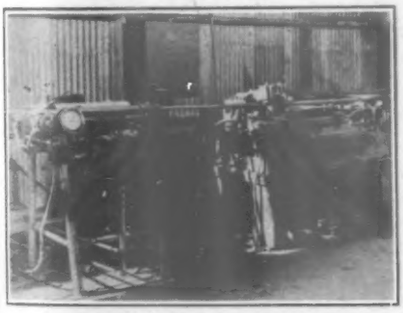
VOLUME 19 | JULY, 1934 | NUMBER 7

Building Reinforcing Cages

for Large Colorado River Aqueduct

■ By JOS. C. COYLE

THINGS are being done in a big way in the construction of the Colorado River aqueduct, which is to carry water stored by the Boulder Dam across the desert to Los Angeles. There are 39 tunnels to be bored through mountains along the route, and one of these is seven miles long. There will also be 27 miles of siphon installations where the aqueduct crosses desert washes between tunnels. This to put it out of danger from cloudbursts. Both monolithic and precast concrete pipe is being tried out for these siphons; 720 ft. of the latter, with an inside diameter of 12 ft. and a reinforced shell 12 in. thick, is being installed near Garnet, northwest of Indio, Calif.,



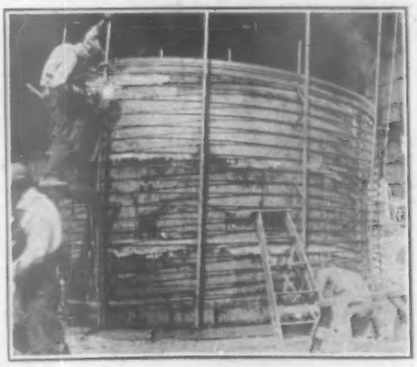
Reinforcing Rod Passing Through Butt Welder and Testing Machine.

by the American Concrete & Steel Pipe Co. and the United Concrete Pipe Co.

Fabrication methods used in assembling the reinforcing cages for these great sections of pipe are of special interest to welders and steel workers because much skill, as well as specially devised equipment, was required to turn out a standard product without costs becoming prohibitive. Common methods of handling steel would have been entirely inadequate. For instance the 1-in. reinforcing rod used in the cages arrived at the plant in 90-ft. lengths. A long conveyor, with dead rollers between heavy angle irons, was installed to bring the rod into the shop after it was lifted from the cars with a crane. Just inside the shop a motor-driven cold saw trimmed each end of the rod slightly. Next the rod passed through a resistance welder which joined the ends. Just beyond the welder, a specially built testing machine subjected the welds to a tensile stress of 39,000 lb., after which rollers carried the rod up an incline to a specially built set of forming rolls on an elevated platform. The bottom roller of this machine was provided with a 4-ft. extension, supported at the outer end by a wooden A-frame which was hinged to the floor and was swung outward when removing a coil of reinforcing rod. The extension held the rod until enough was formed, when the line of steel was either cut with a torch or left unwelded at one of the joints and was then lifted off with a crane.

Welding and Forming the Cylinders

Two types of cage were used: the bar type for sections of the siphon where pressure was lightest, and the cylinder type where pressure was greater. The cylinders are of 10-gage steel, and each was hand welded with 3/16-in. metallic electrodes from 12 sheets sheared to size. The sheets were held edge to edge, while welding, in a specially devised clamp, the



Welding an Angle Cage.

Forming a Cylinder From a Welded Plate.

lower part of which contains a copper contact bar which is forced up against the sheets by air pressure. The sheets were then moved over rollers to a set of rolls, where the cylinders were formed. The sheet was guided by three curved channel sections as it passed the rolls and the overhanging end was then supported overhead by two semi-circular slings of steel channel, with six rollers in each, suspended from hoists.

Removed from the rolls by a crane, the cylinders were then stood on end and held in shape by rings formed of 4x4-in. I-beams. The final longitudinal welds were made and the cylinders carried by overhead hoist to another set of rolls which belled the ends. They were then rolled to a large circular press, where the bell-and-spigot ends were welded on, and stretched sufficiently to produce a plastic flow of the metal, thereby relieving locked-up stresses which might otherwise cause warpage.

This press was specially designed in the shop for this one job, but will be used in other similar work in the future.

In it are twelve separate triangular units, with the outer ends shaped to fit the bell-and-spigot rings, against which they move outward as pressure is applied to a cone shaped hydraulic wedge at the center of the device. This wedge has 12 faces, each of which presses against a section. In designing this machine, the company engineers found it also necessary to develop a special pump, with nine independent pistons, to secure sufficient pressure at the wedge.

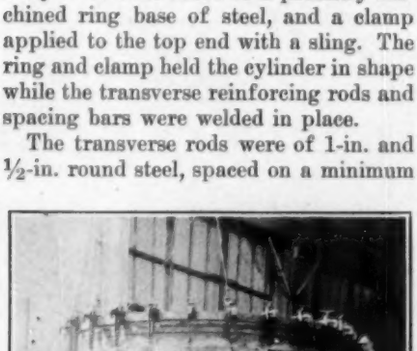
Applying the Wire Mesh Reinforcing

The cylinders were laid down, after removing from this press, and a wire mesh reinforcing was tack welded to the inner face, using ⅛-in. bare electrodes. They were then upended and air-tight

Welding Spigot Ring on Expanding Press.

caps applied to the ends, pressure applied, and all seams tested for leaks. They were next lifted to a precisely machined ring base of steel, and a clamp applied to the top end with a sling. The ring and clamp held the cylinder in shape while the transverse reinforcing rods and spacing bars were welded in place.

The transverse rods were of 1-in. and ½-in. round steel, spaced on a minimum



Testing a Cylinder for Leaks.

of about 2½ in. and a maximum of 6 in. centers with ½x1½-in. spacing channels, the flanges of which face the cylinder. Welded braces of ¼x¾-in. bars connect these spacing channels and hold them to the cylinders. Fingers punched from the spacing channels were bent about the transverse rods to hold them in place. Each cage has 24 rings of each size of transverse rod, applied in elliptical form to resist the external pressure of the back fill. The minor axis is laid at the top and bottom of the trench.

The bar-type cages are the same as described, except that an inner cage is substituted for the cylinder and wire mesh and is welded directly to the bell-and-spigot rings.

Six angle sections were fabricated, having inside radii ranging from 3 ft. 3-11/32 in. to 18 ft. 9-9/16 in. and outside radii ranging from 4 ft. 11-23/32 in. to 28 ft. 6-9/32 in. The cylinders for these were prepared in segments and welded, using from 2 half segments up to 8 full segments and 2 half segments in the longer sections. The longer sections were shipped in units which were then welded in the field. The cages were shipped in wooden cradles on railroad cars, three to a car. Concrete is being poured vertically at the job.

Kenneth Burton Mackenzie
1907 – 1934

Secretary, The Welding Engineer Publishing Co.

Born February 17, 1907. Died June 22, 1934. Son of the late Louis Burton Mackenzie, founder of *The Welding Engineer*, and of Gertrude Hungerford Mackenzie, president of The Welding Engineer Publishing Co. Educated at University of Alabama and University of Chicago, where he attained distinction in football and other athletics. Elected, 1933, Secretary, Chicago Section, American Welding Society. Re-elected, 1934.

A. W. S. to Hold Fall Meeting in New York City

The fall meeting of the American Welding Society will be held concurrently with the National Metals Congress and Exposition, in New York City, during the week of October 1st. The technical sessions of the Society will be held at the Hotel New Yorker, 8th Ave. and 34th St., which has also been designated as Society headquarters. The Exposition will be in the Port of Authority Building, 8th Ave. and 15th St.

Tentative Specifications for Welded 18-8 Steel

Proposed tentative specifications for welded corrosion-resistant articles made from austenitic chromium-nickel steel, were included in the report of Committee A-10 presented at the annual meeting of the American Society for Testing Materials, held in Atlantic City, N. J., June 25th to 29th. These specifications cover properties and tests of the parent metal, heat-treatment and finish, are welding, heat-treatment after welding, and tests and examinations of welded specimens.

British Specifications on Structural Welding

British Standard Specification No. 538, dated March, 1934, on Metal Arc Welding as Applied to Steel Structures, has been published by the British Standards Institution, 28, Victoria St., London, S. W. 1, England. Copies may be obtained at 2 shillings, 2 pence, postpaid. This specification covers requirements for the parent metal, electrodes, design and execution of both butt and fillet welds, working stresses in welds, workmanship, physical tests, supervision and inspection. Appendixes deal with tentative specifications for covered electrodes for hand operation, obtaining all-weld-metal test pieces, making physical tests, and notes on design.

Steel Pipe Made by Automatic Welding

Automatic arc welding is used exclusively by the Southern Pipe & Casing Co., Azusa, Calif., to fabricate a wide range of pipe sizes from steel varying from 14-gage to ⅜ in. in thickness.

With a capacity of from 500 to 2000 ft. a day, the plant is equipped to produce pipe in all sizes from 4 in. up, daily production depending on size. The pipe is formed cold from flat sheets or plates, die-pressing and rolling operations being used. The formed work then goes to one of two welding machines using General Electric automatic arc-welding heads and travel carriages. Welding is done with G-E Type B welding electrode, speeds as high as 30 in. per minute being attained on pipe with the thinnest walls (14-gage). Each welder has its own G-E constant-potential welding generator, resistor, and reactor. Welding currents run as high as 500 amperes for the heavier pipes and welding electrodes. Two G-E single-operator welding sets are used for miscellaneous jobs such as tacking.

Two standard 12-ft. lengths of pipe are welded together to form one 24-ft. section.

Ever since the production of pipe was started by the process described, a record of "no pipe leaks" has been maintained.

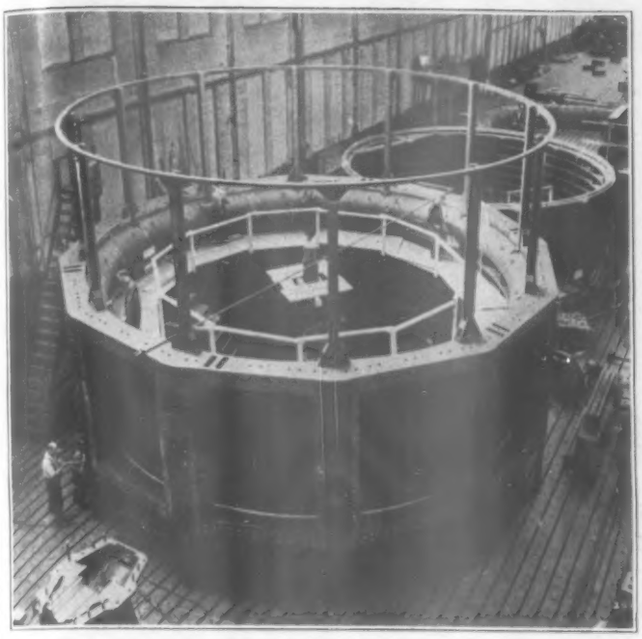


Fig. 1. Assembled View of Gate and Nose Liner

Welding on the Boulder Dam Cylinder Gates and Nose Liners

■ By CHAS. H. JENNINGS
Westinghouse Electric & Mfg. Co.

THE Boulder Dam, power plant and accompanying works, now being constructed in Black Canyon, between the states of Arizona and Nevada, is notable not only for its magnitude, but also for the excellent engineering features which have been incorporated in its design. One of the outstanding engineering features is the unrestricted use of welding in the construction of such vital parts as the penstocks, generators, intake-tower cylinder gates, nose liners and trash-racks, needle valves, etc. This large use of welding is the result of the large strides made by the welding industry during the last few years and the success of the many structures built under the A. S. M. E. Boiler Code, unfired pressure vessel section on fusion welding.

The intake-tower cylinder gates and accompanying nose liners are illustrated in Fig. 1. These control the flow of water from the upstream side of the dam to the 17 generators in the power houses and the outlet works and are of major importance from the standpoint of the satisfactory operation of the entire project. Consequently, the choice of weld-fabricated rather than cast structures was not an experiment but a realization of the superiority of welded rolled steel over cast iron or cast steel for large structures.

Some of the advantages of fabricated rolled steel over castings are as follows: (1) rolled steel has a more uniform structure and can be more closely inspected prior to construction, thereby insuring a more uniform product; (2) there is no danger of hidden blow holes or shrinkage cracks that might cause weaknesses and unsatisfactory service life (this is an important item in castings where ribs and flanges intersect, such as in the design of the gates and nose liners); (3) the close fabricating tolerances cannot be as satisfactorily controlled with castings as with fabricated structures; (4) machining is easier because the frequent variations of microstructure and hardness of castings are not present, and (5) pattern costs and coring problems are eliminated.*

Design of Cylinder Gates and Nose Liners

In order thoroughly to appreciate the magnitude and importance of the cylinder gates and nose liners, it is necessary to understand their location and function in the intake towers. A sectional view of an intake tower showing the location of the gates, nose liners, entrance liners and throat liners is shown in Fig. 2. The entrance liners are semi-steel castings, thoroughly grouted into the concrete walls of the intake towers, which afford a metal path for conducting the water from the surrounding reservoir through the tower walls. There are twelve entrance liners equally spaced around the tower at each gate location (see Fig. 2), thereby allowing twelve radial inlets for the water at each gate.

The fabricated steel nose liners bolt to the inner edges of the entrance liners, bridge the small section of concrete be-

*It is important to note that the throat liners and entrance liners for the gate assembly were of cast construction. This was done because they were simple in design and relatively small, and the patterns, with slight alterations, were suitable for both the upper and lower gate assembly segments.

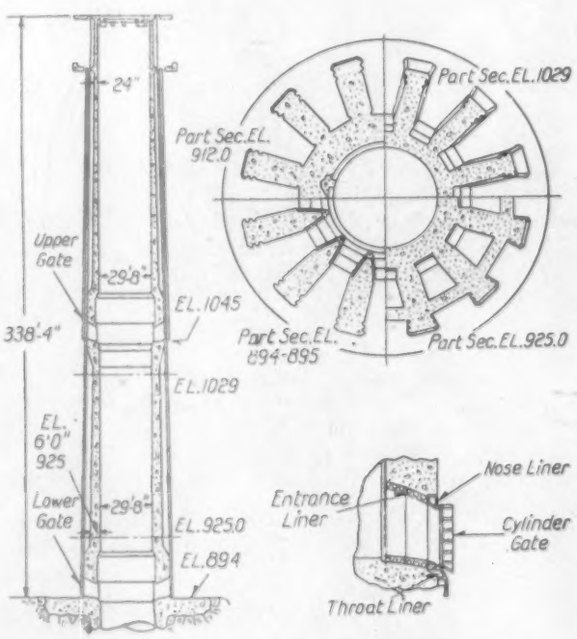


Fig. 2. Section of Intake Towers, Showing Location of Gates.

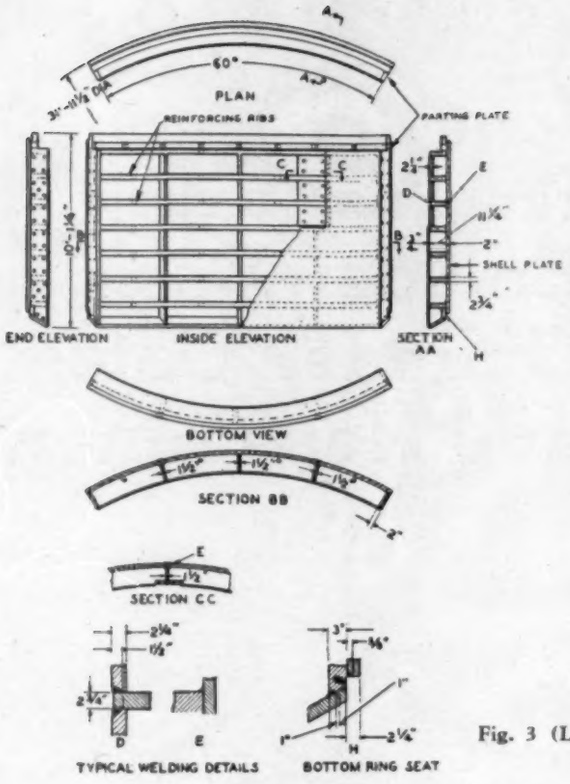


Fig. 3 (Left). Detail of Lower Cylinder-Gate Segment.

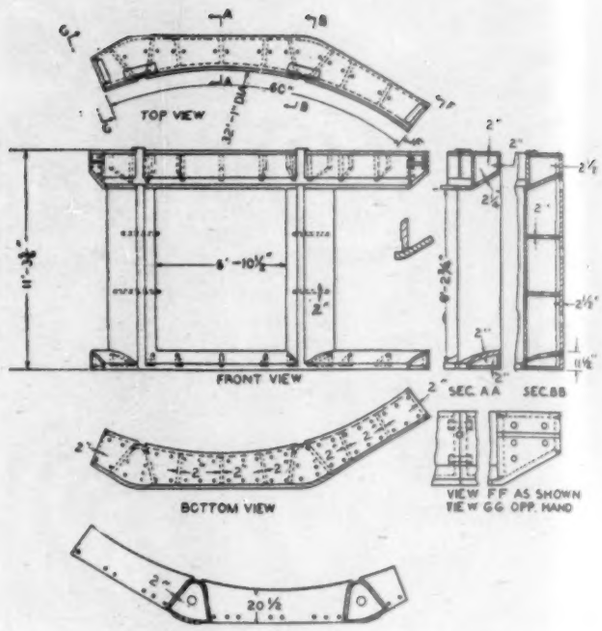


Fig. 4. Detail of Lower Nose-Liner Segment.

tween the entrance liners, and afford a guide and seat for the cylinder gate.

The cast throat liners are grouted to the inner periphery of the intake towers and form a seat to which the nose liners and lower monel-metal seats are bolted (see Fig. 2).

The gates proper are essentially hollow cylinders which slide up and down inside the nose liners in the manner of a valve. Both gates and nose liners are equipped with monel-metal seats so that when the gates are lowered they come in contact and effectively seal the openings to prevent water from flowing from the reservoir into the towers. To allow the water to flow into the towers and the penstocks, which are attached to the throat liners of the lower gate assembly, the gates are raised by means of hollow rods (three per gate) bolted to the gates.

Drawings for lower gate and nose liner segments are shown in Figs. 3 and 4, respectively. The design of the upper and lower gates and nose liners are similar except for plate thicknesses and minor details. The lower gates have a metal liner screwed to their inner periphery for the purpose of producing a smooth surface, thereby reducing friction losses when the upper gates are in use (this liner is not designed to add strength to the gates). No cross bracing is used to strengthen either the top or bottom gates.

The gates and nose liners were fabricated in segments, six of which were required to make a complete unit. After each segment was welded it was strain annealed (see Fig. 5). The complete gates and nose liners were assembled to form the complete structures by means of stainless-steel bolts (see Figs. 6 and 7). No welding was required on the gate segments after they had been annealed. The only welding required on the nose liners after annealing was a small seal and weld at the parting joints after erection.

Technical data pertinent to the cylinder gates, nose liners and throat liners are as follows:

Dimensions

Cylinder Gates (Upper and Lower)	
Outside diameter	32 ft.
Inside diameter, approx.	30 ft.
Height	10 ft.
Nose Liners (Upper and Lower)	
Outside diameter	37 ft.
Inside diameter	32 ft.
Height	11 ft. 6 in.
Throat Liners (Upper and Lower)	
Outside diameter	37 ft.
Inside diameter	30 ft.
Height	4 ft. 5 in.

Materials Used

Copper-bearing steel plates	3,440,000 lb.
Ferrous castings	850,000 lb.
Bronze strips and castings	87,500 lb.
Monel-metal seats	111,240 lb.
Monel-metal screws and bolts	15,000 lb.
Stainless-steel bolts	34,000 lb.
Steel bolts, studs, nuts	30,000 lb.
Structural shapes	14,500 lb.
Welding rod	10,000 lb.

Linear Inches of Welding

Four upper cylinder gates	161,160 in.
Four lower cylinder gates	143,688 in.
Four upper nose liners	112,800 in.
Four lower nose liners	112,800 in.

Weights

Upper gate	147,000 lb.
Lower gate	240,327 lb.
Upper nose liner	149,000 lb.
Lower nose liner	183,800 lb.
Upper throat liner	74,640 lb.
Lower throat liner	82,830 lb.

While the construction of the cylinder gates and nose liners involved many problems, such as forming and preparing the parts for welding, erection for welding, adapting the machine tools for machining the finished structures, inspection, etc., only the welding problems will be considered in the following:

Welding and Plate Specifications

All welding was required to be done in the shop and to conform to the current rules for the fusion process of welding, Class 2, of the A. S. M. E. Boiler Code.

The plates joined by welding were required to be accurately cut to size and shape and the edges prepared so as to allow thorough fusion and complete penetration on all joints. Flame cutting was permitted, provided it was done by machine. Contour irregularities at critical stress points were required to be removed by welding and grinding.

The welding process was required to be under control at all times and only skilled welders capable of meeting the qualification tests for welders as specified in the "Rules for the Fusion Process of Welding, Class 2, of the A. S. M. E. Boiler Construction Code, Unfired Pressure Vessel Section," were permitted to work on the job. Each deposited layer of weld metal was required to be thoroughly cleaned and peened before depositing the succeeding layer. The finished welds were required to be reasonably smooth and free from grooves, depressions, undercut, and other irregularities.

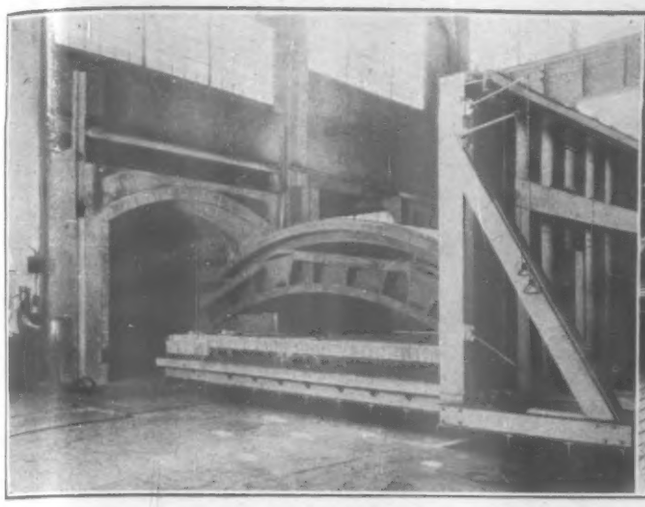


Fig. 5. Gate and Nose-Liner Segments Ready to Go Into the Electric Annealing Furnace.

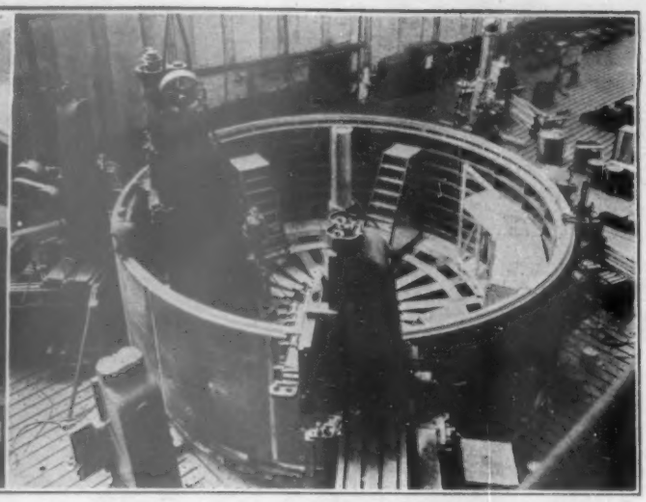


Fig. 6. Complete Cylinder Gate, Composed of Six Segments Bolted Together.

After each segment was completely welded it was required to be annealed at the proper temperature for a period of time not less than one hour per inch of maximum thickness of metal and allowed to cool slowly in the furnace.

The specifications for the steel plates required that they be made by the open-hearth method, that they contain 0.2% to 0.3% copper, and that they have a yield strength of not less than 24,000 lb. per sq. in. (the yield strength being designated by 0.2% permanent elongation of the original gage length).

The actual physical properties of the plate material used were approximately as follows: yield point, 27,000 lb. per sq. in.; tensile strength, 58,500 lb. per sq. in., and elongation, 36% in 2 in. The approximate chemical analysis was as follows: C 0.23, Mn 0.56, P 0.029, and Cu 0.24.

Qualifying the Welding Operators

Since the welding specifications required welding of A. S. M. E. Boiler Code, Class 2 quality, this necessitated that all welders pass the necessary test requirements before being allowed to weld on the job.

A suitable training course for instructing welders to do quality welding consists of a day of demonstrations and special instruction to inform the welder of the proper welding technique and the quality of weld required, followed by five to ten days of practice under the supervision of the instructor (the exact length of this practice period depends upon the ability of the welder).

The practice welding should consist essentially of making butt welds on plates about 15 in. long and having a thickness corresponding to the maximum size of welded joint in the structure, and subjecting them to a nick-break test. When a welder is capable of making welds giving a nick-break fracture free from gas holes, slag inclusions and poor fusion, he will be capable of making welds that will meet the requirements for tensile strength, ductility and soundness as specified by the Boiler Code (this conclusion, of course, is dependent upon the use of a high-quality welding electrode that has been proven to produce welds of Boiler Code quality). Typical nick-break fractures made by welders are shown in Fig. 8.

In addition to making butt welds during the practice period, a welder should also practice on fillet welds, if they are to be used on the structures to be welded.

In cases where welders fail to pass their final tests, they should be told the reasons for their failure and given special instructions on how to correct them. They should then be required to practice for several days before again being permitted to make another test plate.

In all, about 80 qualified welders were used in the construction of the Boulder Dam cylinder gates and nose liners.

Selecting the Welding Electrodes

The requirements of the A. S. M. E. Boiler Code for Class 2 welding include the following: tensile strength by full-section tensile specimen, not less than the minimum specified tensile range of the plate; tensile strength by reduced-section tensile specimen, not less than 95% of the minimum specified tensile range of the plate; ductility by free bend, 20% elongation, and nick-break fracture,

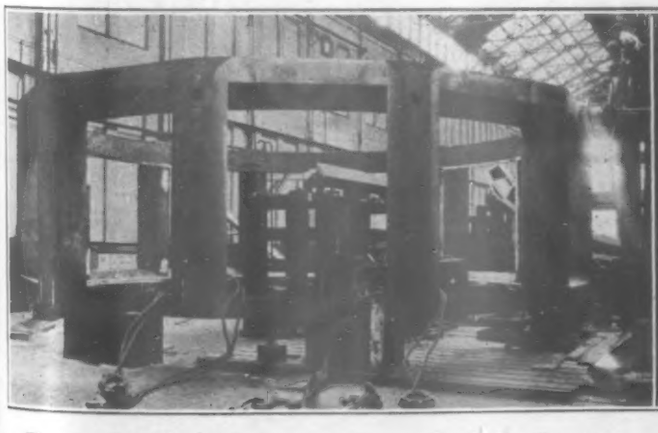


Fig. 7. Complete Nose Liner, Composed of Six Segments Bolted Together.

Fig. 8. Typical Nick-Break Fractures of Welded Specimens, Showing Sound, Homogeneous Weld Metal.

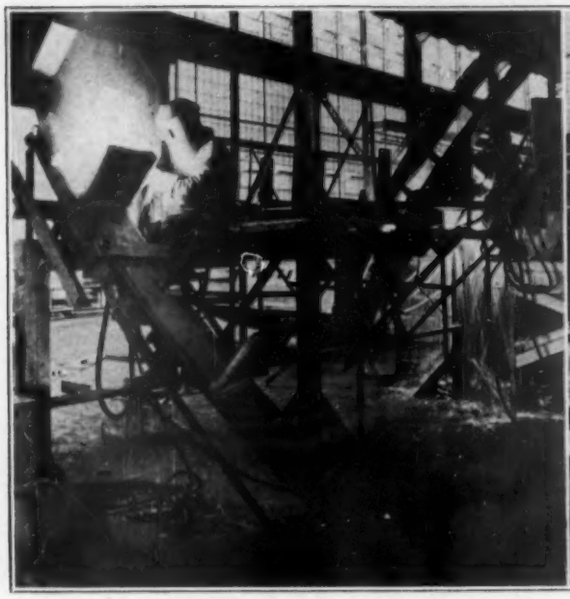


Fig. 9. Welding Spacers to the Longitudinal Reinforcing Ribs of a Gate Segment.

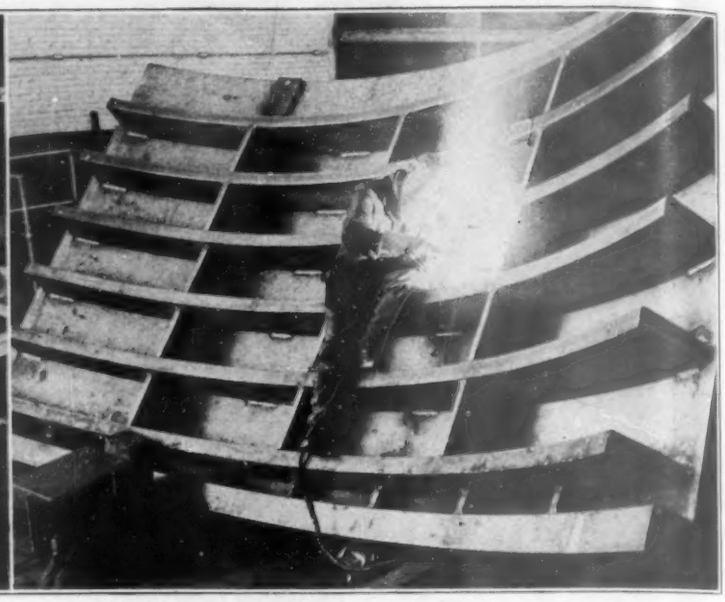


Fig. 10. Welder Making Longitudinal Fillet Welds on a Gate Segment.

sound clean metal with not more than 6 gas pockets 1/16 in. maximum diameter per square inch of weld surface exposed in the fracture. This necessitates that all welds be made with a high-quality fluxed electrode. The electrodes used throughout the entire job were of the Westinghouse "crucible weld" type. The quality of the welds made with these electrodes actually met all the physical requirements of the A. S. M. E. Boiler Code, Class 1 welding.

Qualification specimens made by welders produced the following typical results:

(a) Full-section tensile: Failure in the parent metal at an ultimate strength equal to that of the parent metal (55,000 to 65,000 lb. per sq. in.).

(b) Reduced-section tensile: Failure in the parent metal at an ultimate strength equal to that of the parent metal (55,000 to 65,000 lb. per sq. in.).

(c) Ductility: 30% to 50% by free bend.

(d) Nick-Break: Maximum of one to two holes less than 1/16 in. in diameter in a specimen with 4½ sq. in. of exposed surface in the fracture.

The diameters of the electrodes used were 3/16, ¼ and 5/16 in. The 3/16-in. diameter electrodes were used primarily for tacking and for depositing the first beads in the bottom of butt welds where the gap was too narrow to obtain good penetration with ¼-in. electrodes. Electrodes of ¼ or 5/16 in. diameter, depending on the size and location of the weld, were used to finish the butt welds. All fillet welds were made with ¼-in. diameter electrodes.

In discussing the design of the joints it is only necessary to consider the butt joints.

Designing the Butt Joints

Resulting from the particular design of the structures (see Figs. 3 and 4) it was necessary to make most of the joints of the single-bevel type. A few joints were of the single-V and double-V types, but they were a very small percentage. The included angle between the kerfs of the single-bevel joints was held as closely as possible to 45°, and the included angle between the kerfs of the single- and double-V joints was held to about 40°.

At first thought these angles might seem small, but extensive tests and investigations revealed them to give the best results. The only difficulty that might be encountered by using small included angle joints of this type would be obtaining good penetration at the bottom of the joint. This difficulty was completely eliminated, however, by slightly spacing the butting edges wherever possible and/or by depositing the first beads with small (3/16-in. diameter) electrodes.

The advantages of the small included angle were as follows:

(1) It reduced the amount of weld metal required in making a joint, thereby reducing the welding time and the cost.

(2) The smaller amount of deposited weld metal reduced the local heating in the structure and reduced the residual stresses.

(3) It cut down the maximum width of the joint and made it possible to weld the full width of the widest joints at a single pass without excessive weaving. It has been found that, if a very wide weave is used with fluxed electrodes, the pool of molten metal becomes too large, thereby resulting in overheating of the deposited weld metal and excessive undercutting.

As mentioned before, this article is intended only to discuss the welding procedure and technique used in connection with this project. Also, because the designs of the structures are so complicated, it is not possible in the space of this article to go into very great detail. As a result, only the more important phases which are directly responsible for obtaining satisfactory results will be discussed.

Welding Procedure for the Cylinder Gates

The upper and lower cylinder gates are of essentially the same design; consequently, the same general welding procedure was used on both. Therefore, only the lower gates, which were the first to be fabricated, will be considered.

The fluxed electrodes used are primarily adapted for horizontal welding. Because of this fact, and in order that larger electrodes might be used and greater welding speeds obtained by horizontal welding, the gates were tilted in various positions during the welding process so that all the joints could be welded in such a position. When making fillet welds, the structures were tilted approximately 45° in order to form a trough and assimilate a butt weld.

Tilting of the complete gate segments into the many necessary welding positions was a large task; consequently, wherever it was possible, parts were individually assembled before the complete assembling of the segments. This procedure made possible the use of simple fixtures such as shown in Fig. 9. The simplicity of the jigs and the small sizes of the parts welded in such cases aided greatly in increasing welding speeds.

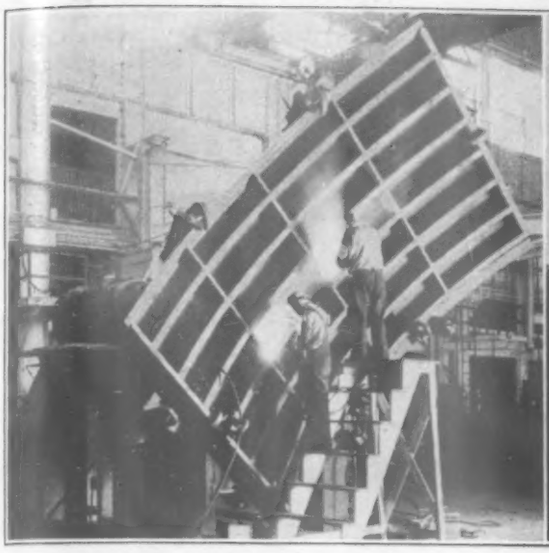


Fig. 11. Welding Rib Spacers in Place With Fillet Welds.

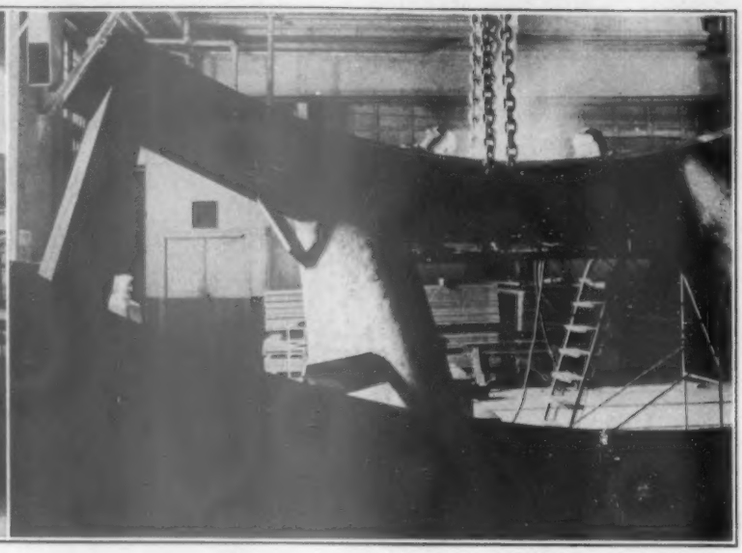


Fig. 12. Operators Making Fillet Welds on a Nose-Liner Segment Which Is Supported by a Crane.

After the necessary individual details were welded, the complete segments with the exception of the parting plates which are attached to the ends of the reinforcing ribs (see Fig. 3) were assembled in a jig and tack welded together. The tack welds were made with fluxed electrodes and were ½-in. welds, approximately 6 in. long. The location of the tack welds are clearly shown in Fig. 10.

After the gate segments were tack welded together they were removed from the assembly jig, and the reinforcing ribs, the rib spacers and the shell plate completely welded together, after which the ends of the ribs were machined and beveled and the parting plates attached and butt welded into position.

All Fillet Welds Made in Three Layers

Fig. 10 shows a gate segment tilted in approximately a 45° position for making the fillet welds between the reinforcing ribs and the shell plate. These welds were made in short lengths (about 8 in. long) the full thickness of the finished weld, working progressively from the center of the segment toward the outer edges. Three layers made with ¼-in. electrodes were used to make the welds. The purpose of this procedure was to prevent as much as possible the presence of any welds smaller than the finished size. Making welds by depositing single layers the full length of the joints was not practicable because the uneven heating and cooling of the thick, heavy members would have caused them to crack. Constructing the welds so that all but the immediate section being welded were full size, eliminated this difficulty.

Butt welds were also made by progressing from the center of the joint toward the ends.

In order to properly weld the rib spacers and parting plates in place the segments were mounted on a fixture as shown in Fig. 11. This fixture was constructed so that the segments could be both rotated and tilted inward or outward. This made it possible to place the segment at any desired angle or position for welding.

In addition to the above the following general rules were followed:

(1) All layers of deposited weld metal were peened with a blunt-nosed peening tool operated by a light chipping hammer, in order to reduce residual stresses and to clean the weld. The peening operation was carried out immediately after the deposition of each 6 to 8 in. of weld metal. Peening in this manner before the deposited metal became cold gave better results.

(2) After welding was once started on a gate segment it was continued, as nearly as possible, to completion without interruption. This procedure prevented the segments from being successively heated and cooled, and consequently reduced the thermal strains.

(3) All tack welds were chipped out during the main welding process. Although this procedure was not necessary in all cases, it was found to produce the best results because of the danger of welding over a tack that contained an initial crack.

(4) Special attention was given by each welding operator to all craters. For the best results, it was found desirable to fill all craters before breaking the arc. This was accomplished by lengthening the arc slowly before breaking it.

Procedure for Welding the Nose Liners

The nose liners, as shown in Fig. 4, were made in the same general manner as the cylinder gates. Wherever possible individual sections, such as the noses and top-ring, were separately welded before being introduced into the general assembly. The general assembly was accomplished by placing the various parts in a jig and tack welding them together. During this assembling process numerous braces were added between the members to prevent their warping and distorting out of shape. Fig. 12 shows the location of some of the braces applied.

In order to tilt the nose liners so that all welding could be done in a horizontal plane they were suspended by means of overhead cranes (see Fig. 12). This system afforded a quick, cheap means of support and turned out to be highly satisfactory.

The complete welding procedure for the nose liners is too long and complicated to include in this article. It is sufficient to state, however, that the sequence of welding was arranged so as to develop the minimum amount of handling and the minimum amount of distortion of the finished product. The same general rules and methods of making butt and fillet welds as outlined for the cylinder gates were used in this case.

Annealing the Welded Parts

After completing the welding of each gate or nose liner segment, it was strain-relieved in an electrically heated annealing furnace at a temperature of approximately 1300°F. (see Fig. 5). The annealing cycle consisted of 18 hours to bring the furnace up to temperature, 3 hours soaking time at the required temperature, and 14 hours to cool the furnace to 100°F. before removing the parts from the furnace.

During the welding processes the gates and nose liners had a tendency to warp slightly out of shape. This condition was

effectively corrected during the annealing process by placing weights on top of the segments and proper supports underneath them. The proper location of the weights and supports caused the segments to bend back into their proper shape during the annealing process. (The maximum out-of-round on the finished gate segment was +¼ in. on the diameter.)

The welding methods and procedures employed on this job are particularly adapted to the fabrication of heavy structures and, with slight modifications, should be suitable for any job composed of large rigid members.

Publishes Regulations on Acetylene Cylinders

Regulations in effect in various countries governing the construction and use of dissolved-acetylene cylinders have been published in outline form on a 22x36-in. sheet, by the Eleventh International Congress on Acetylene and Autogenous Welding, held in Rome, Italy, June 5-10, 1934. The chart is in the French language.

Get "*H. O. T.*" on Welding

■ By H. O. T. RIDLON

[This section is dedicated to Better Welding and Better Welding Shops. Suggestions and criticisms are invited.]

Preheating Castings For Welding

Some of my good friends have written in about the welding of iron castings, both large and small, and particularly seeking "info" about preheating, so the Old Maestro will, with word and picture, pass along a few thoughts on said subject, for all of my gray hairs have been caused by expansion and contraction. So those guys that know all there is to know about cast-iron welding can just skip this, for it is not intended for them, but for the less fortunate brothers who like myself are continually seeking knowledge of our art. Read on!

First, I wish to give you a good rule-of-thumb to follow in the welding of castings, which I have found helpful, for we are all inclined to follow the easiest way. But on welding cast iron I have

Preheat Oven Using Blow Torch.

found that it is best to tackle the hardest part of the job first. That is usually the heaviest section, and will hold the heat while you are finishing up the easier part of the job.

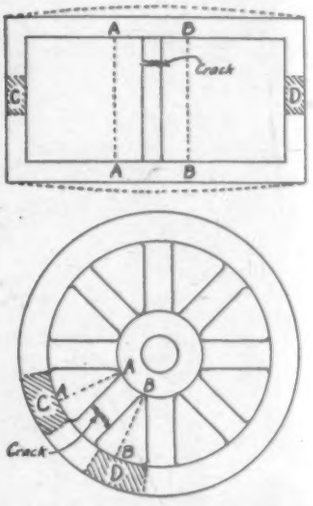
Another thing that I have noticed is that most welders work or try to weld cast iron too cold. It is really quite hard to burn cast iron, so work it while hot. Get it flowing real freely and keep puddling your rod in the job. It may seem that you are taking a long time to build up your groove or that your metal is running away from you. If the latter is true, use carbon plates, building a dam (not damn) so that the molten metal will stay where you want it. I have noticed so many shops where they hardly knew what carbon plates are to say nothing of knowing what they were for. Yes sir, they are something that every repair shop that does welding should always keep on hand. And another thing lacking in most shops is a sufficient supply of charcoal, if any. Always be ready for any job that might come your way and not have to waste time chasing up this and that at the last moment, for that is very costly and may cause you to miss some darn nice profit. And that is the thing we are always seeking; for without that elusive little creature we soon fail to live.

Now, some more about charcoal. As you youngsters visit the shops run by the old timers you are very apt to find large quantities of charcoal. Now, kids, here's some "low down" for you. Most of the old boys have some time or other tried using a blow torch of one kind or other, depending on the best and cheapest fuel available, and lacking certain knowledge have given it up as a bad job and returned to their old love, charcoal, because of its slow, clean even heat. Now here is a thought for you. We have all seen furnace grates that have the appearance of being badly burned. It is caused from the iron being oxidized while it is kept hot for long periods.

Herewith is shown a layout for a preheat oven using a blow torch. The job is supported on two heavy rails or I-beams. In welding a fancy or intricate casting do not allow the flame to play on the casting at any time, but circulate around it, first going around the furnace one way and then the other. At the beginning when you start to preheat your casting, do not have the torch open more than half way, until the casting gets to a nice, even heat all over, then you can open up your torch full blast and give it the works. There are two things about this preheat oven that are different from the conventional type—there are no draft holes in it and the corners are rounded so that they will assist in circulating the flame. And naturally it is larger because we cannot play the flame on our job.

When your job is ready, jump right to work on it and finish up as quickly as possible, working through the asbestos paper on top. When you have finished the job and it has cooled down too much, give a little warming with your blow torch. Cover it over with asbestos paper and close up the door in front and leave it right in the furnace. Of course, if it's just a plain, big casting, you can put two and sometimes three blow torches on the job. Kerosene is my favorite preheat fuel. Gasoline gives a nice heat and clean, but it is more dangerous. Natural or city gas is good if cheap enough and available.

In one of the drawings, I have tried to give a picture of a cast frame with a



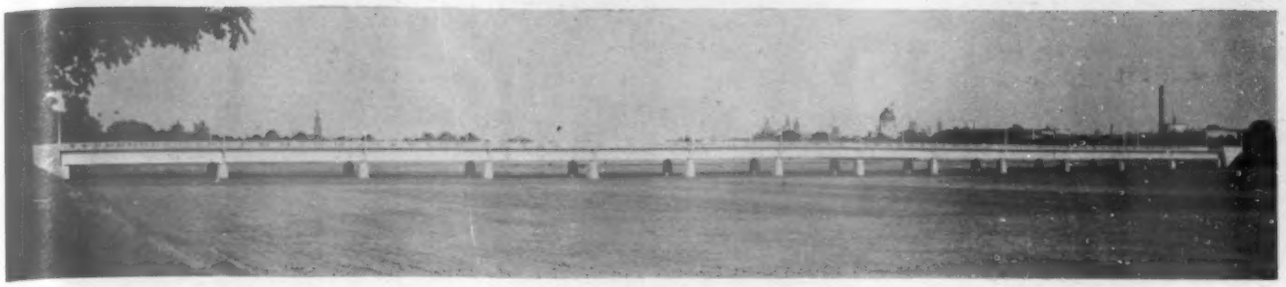
Illustrating Proper Preheating of a Frame and a Wheel.

crack in a rib. Now picture your finger wedged in that crack. Naturally you want to get it out, so you apply pressure from A to A and B to B with jacks. But in welding this would cause a bow, as shown by the dotted lines. This we do not want, so by heating areas C and D we will arrive at the same result of spreading out the crack for welding, which is really the thing to do in welding a casting of this type.

The third diagram shows a wheel with one of the spokes broken. And durn it, but the old finger is wedged down there again in the crack. So we would apply pressure with jacks from A to A and B to B and we'd get the old finger out. But if we apply a local heat in areas C and D, depending on the size of the casting, we arrive at the same result, and are now ready to make our weld.

• • •

The thought for the month: You have to keep working to keep living!



Details of Design and Construction of the World's Largest Welded Bridge

■ By RENE W. P. LEONHARDT
Consulting Engineer, Berlin, Germany

THE construction of the new Schlachthof bridge in Dresden, Germany, which is 1040 ft. long and crosses the Ostra tidal channel (a floodwater tributary of the river Elbe) in 13 spans, each of from 72.5 to 86 ft. long, denotes an engineering feat of paramount importance both from a technical and economic aspect.

A few years back, as a result of exhaustive tests on welded bridges, the German Reichsbahn framed official regulations for the construction of welded steel structures. These rigorous investigations conclusively affirmed the technical merits of welded bridges, and in respect to economy, likewise authenticated their undeniable superiority over riveted constructions.

In this connection, the fact must not be overlooked that, especially in Germany, riveted structures have attained a very high standard and in some cases must be regarded as the acme of engineering achievement. Welded bridges have therefore succeeded in the face of a very worthy competitor, and economically now occupy an unassailable position.

Plate Girders, Hand Rails and Tramway Poles Were Welded.

Simplification Produced by Welded Design and Construction

Welded construction brings important simplifications in its train; for instance, the avoidance of larger cross-sections for the various girders and of fishplates and overlappings owing to the omission of rivets and rivet holes, and the better and more convenient distribution of the structure materials in consonance with static requirements. In sheet-metal girder construction, the saving in weight is about 15% to 20%. This naturally also affects the design and arrangement of the pillars and foundations. Finally, the design work in preparing the working drawings is simplified so that the drafting can be completed in a much shorter time.

All these simplifications make for economy, with the result that of all the tenders submitted for the Schlachthof bridge in Dresden—about 40 firms participated—the tender for a welded bridge was not only the lowest in relation to all riveted designs but also to wooden bridges.

This result must have been cause for some astonishment in technical circles. In the light of such economic advantages as low first cost, rapid completion of the work, low overhead expense, favorable amortization, etc., certain important features of the welded construction of the Schlachthof bridge are of great interest at this time.

THE bids for this 1040-ft. structure included welded, riveted, and wooden constructions. The lowest tender was for a welded bridge. The new structure had to be erected exactly in line with the wooden bridge it replaced, without undue interference with traffic.

The technical and economic success achieved by this bridge becomes all the more conspicuous when considering the difficult circumstances under which the bridge had to be built. For example, it had to be erected exactly in line with the previous wooden bridge without creating undue interference to traffic. Furthermore, the final construction had to be such as to allow of carrying out a reconstruction at some future time—for example, lifting the entire bridge so as to meet the new conditions prevailing in the event of an extension of König Albert's harbor.

The difference in the spans of from 72.5 to 86 ft. may be ascribed to the above requirements. The twelve pairs of pillars, which are positioned in the immediate vicinity of the former wooden supports, are of hexagonal shape. On them rest the main plate girders (6.6 ft. high and ½ in. thick) spaced 29½ ft. apart. Twenty-two roller bearings and six rigid bearings are used where the main girders meet the pillars and abutments. In order to exclude the detrimental effect of depression of the supports, the main girders are arranged as hinged beams.

Cross and Main Girders in Place.

The web plates of the main girders are

of 1-in. plate. The flanges, apart from the positions at the bearings, which are specially overlapped, consist mostly of a single plate 11¾ in. wide and between ⅞ and 1-13/16 in. in thickness. These flanges are welded directly to the top and bottom edges of the web plates with 7/32-in. fillets.

On each side of the girders, vertical plates of 1-in. thickness are welded to the web and flange plates, and act simultaneously as connecting and reinforcing members.

Where the ends of the flange plates of the main girders were butted together, they were cut to form a V, and the joint

Angles Were Welded on Top of the Cross Girders to Embed in the Concrete Roadway.

welded on both sides by a fillet and a V-seam. Tensile tests of this type of joint gave satisfactory results.

The cross-girders, which are spaced at intervals of about 13 ft., are of much lighter design than the main girders. They consist of web plates 3 ft. 10 in. high and ⅜ in. thick, which, similar to the main girders, are welded to flange plates 11¾ in. wide and 9/16 to 11/16 in. thick. The web plates are reinforced by flats and T-sections which are continuous fillet seam welded by hand. Welded joints are intentionally avoided when connecting the cross-girders to the main girders in order to reduce the welding work on the building site to the minimum. The cross-girders were therefore riveted to the vertical ribs of the main girder, plates and angles being used for connections.

No Wind Bracing Necessary

A point of special interest is the absence of wind bracing. The considerable wind pressure acting upon the main girders is taken up by the reinforced-concrete roadway platform and transmitted to the bridge pillars. The wind forces are transmitted from the main girders to the roadway platform by short lengths of heavy angle sections which are welded on to the top flanges of the cross-girders and are firmly surrounded by the concrete mass of the roadway platform. The rigid connection and the friction between the roadway platform and the steelwork also obviated the necessity of a special group of girders to resist braking. The construction is so arranged that horizontal forces, transversal to the longitudinal axis of the bridge, are transmitted to the pillars without preventing displacement in the longitudinal direction of the bridge.

These constructional innovations, too, result in a saving of weight and greatly promote the technical and economic factors outlined in the opening paragraphs of this article.

The approximate weights are:

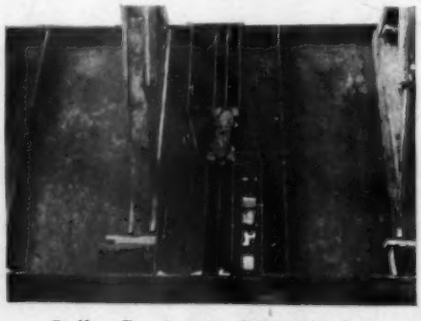
Main-girders	299 tons
Cross-girders	132 tons
Bearings and joints	24.5 tons
Erection bracing, angle-pieces, weather brackets and fixtures of the tramway poles	12.5 tons
Total weight	468 tons

Special precautions were taken in respect to the expansion joints of the roadway platform, across which the wind forces must be guided to the adjoining section of the platform.

Roller Bearings at Expansion Joints

The main girders, which retain their normal length at a temperature of 10° C. and expand or contract to the extent of 3⅛ in. at the highest and lowest temperature levels during the warm and cold seasons of the year, and can thus experience a longitudinal alteration of 6¼ in. due to the fluctuations in heat, are each equipped with two elongation devices, devised as simple roller bearings, which are fitted about every quarter or three-quarters of the length of the bridge. As the web plates and flange plates of the main girders are interrupted at these points, web plates, 1 in. thick, with particularly strong reinforcements, were selected.

The roadway platform has a width of 33½ ft. between marginal planks. On



Roller Bearing in Main Girder.

the left and right of it is a footway 6½ ft. wide, including railings. In the middle of the roadway platform are the rails for a single-track tramway.

Modern manual and automatic welding apparatus were employed. Based on unit length, welding by means of automatic welding machines—which are economical for long seams—was about 75% cheaper than manual welding. The length of the seams welded amounted in all to 8¾ miles.

Testing and Inspection

All parts of the bridge are subjected to a static stress (dead load), on which are superimposed the widely fluctuating dynamic stresses (wind pressure, vehicles, temperature fluctuations, etc.). As a check on the ability of the welds to withstand such loads, it was decided to test the strength of the welded seams. Thirty specimens were welded by fifteen welders and then examined on the tensile

Flange Plate of Main Girder Prepared for Butt Welding.

tester. The ultimate strengths varied between 36,000 and 54,000 lb. per sq. in., the average being 45,000 lb. The lowest ultimate strength attained was still 28¾ lb. above the required normal ultimate strength. Moreover, acting on the instructions of the public works department of the town of Dresden in its capacity as the management of works, 190 testing points were milled out on welded specimens and treated according to Schmuckler's process, by which a section of the weld is exposed for examination. Only at three of these points were the welded seams not quite perfect, whereas at some of the other points examined, the requirements of the specification were far exceeded. The results were arranged in order of quality and a record was made of the average welding performance of each welder, allowance being also made for the extent by which the poorest or best welding specimen deviated from the average. Such a thorough test and supervision of the welders had a very favorable influence upon the execution of the entire construction.

Comparative Data on Automatic and Manual Welding

The employment of the automatic welding machine also contributed towards a better distribution of the forces, because in order to work economically with the automatic welder, thin continuous seams are usually welded. These are superior to thick interrupted seams, for they suppress the peaks of the stresses arising in the parent material.

The following figures are based on actual welding time, both manual and automatic, during construction:

Manual Welding With Coated Electrodes

Thickness of seam, in inches	Welding capacity, in feet per hour
3/16	6.6
¼	4.6
⅜*	3.0
7/16*	1.65

*Made in two layers.

Automatic Welding With Core Electrodes

Thickness of seam, in inches	Welding capacity, in feet per hour
3/16	16.5
¼	13.2
⅜*	6.6
7/16*	3.3

*Made in two or three layers.

It was proved that when using quick-melting core electrodes, the welding speed of the automatic machine can be increased up to 1.8 times the specified values. The above data do not include the time required to assemble and tack the structural parts, but they include the time for mounting the track of the automatic welder and welding-head carriage in position, as well as for the other preparatory work for welding.

The electrode consumption per foot run of welded seam was as follows:

Manual Welding

Thickness of seam, in inches	Diameter of electrode, in inches	Electrode consumption, in pounds per ft. of weld
3/16	5/32	0.167
3/16	3/16	0.21
¼	3/16	0.354
⅜	1st layer 5/32, 2nd layer 3/16	0.865
7/16	3/16	1.27

Automatic Welding

Thickness of seam, in inches	Diameter of electrode, in inches	Electrode consumption, in pounds per ft. of weld
3/16	3/16	0.20
3/16	3/16	0.20
¼	3/16	0.33
⅜	7/32	0.79
7/16	7/32	1.13

Apart from the automatic welder's greater hourly performance (up to 2.85

Welding a Plate Girder.

times) as compared with manual welding, the electrode consumption is also smaller. No noticeable slag content in the welding seams was observed with coated electrodes.

The following particulars regarding costs will be of interest:

Total cost, including work on the south ramp.....520,000 R.M.
Cost of the entire steel structure including railings and painting.....395 R.M. per ton
Cost of the reinforced-concrete construction..5.4 R.M. per sq. ft.
Total cost of the bridge per sq. ft. of track and footway .....13 R.M. per sq. ft.
1 R.M.=approximately 38½ cents.

Bridge Roadway of Welded Steel Plates

By D. BRUCE JOHNSTON

A battledeck type of welded steel floor, consisting of ½-in. plate and covering an area of 262x44 ft., forms part of a new bridge structure being erected by the American Bridge Co. for the Illinois State Highway Department, spanning the Chicago Sanitary Canal a few miles west of the Chicago city limits.

The illustration shows part of the welded plating, the background being one of the I-beam approach spans, with reinforced-concrete floor. The other approach

Butt Welds and Plug Welds in Bridge Flooring.

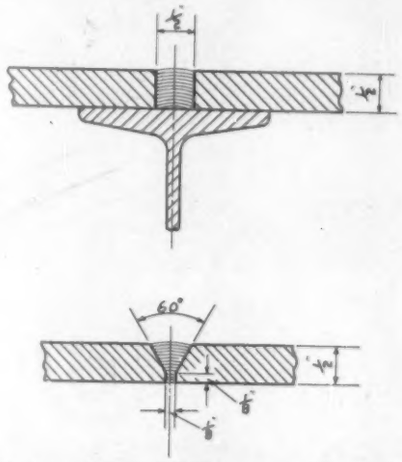
span is also of the same general construction.

The main plate girders for the steel floor are 4 ft. 0 in. deep, and span transversely at 21-ft. 10-in. centers. To these are attached stringers of 12-in. 31.8-lb. I-beams with 1-ft. 8¾-in. centers. The tops of the longitudinal stringers are so arranged as to give the road a camber of 4½ in. at the center, though the transverse girders remain level. The floor of the bridge itself has a 1.36% grade.

There are seven plates across the width of the bridge. Each of the three inside plates spans the distance between four stringers, and each of the other plates spans the distance between five stringers. Where the plates cross the stringers, plug welds are employed, these being 11/16 in. in diameter and arranged in two parallel lines at 3-in. centers and spaced at 3 in. alternately.

The diagrams show the design of the transverse and longitudinal butt joints. All transverse joints are beveled and have no backing plates. The longitudinal joints are not beveled, but the stringers form a backing on which to weld.

Longitudinally, along the outer edges of the curb, 1x1x⅛-in. angles are welded, the welds being 1 in. long and spaced alternately on 6-in. centers. Angles of



Design of Butt Welds. Top—Longitudinal Joint. Bottom—Transverse Joint.

the same size are also placed across the direction of flow of traffic at 10-ft. 0-in. centers and welded in a similar manner.

On each side of the bridge are ten downspout inlets placed centrally between the cross-girders. These provide openings 1 ft. 3½ in. long and 9½ in. wide, each of which has a framework of 1x1x⅛-in. angles welded around the top.

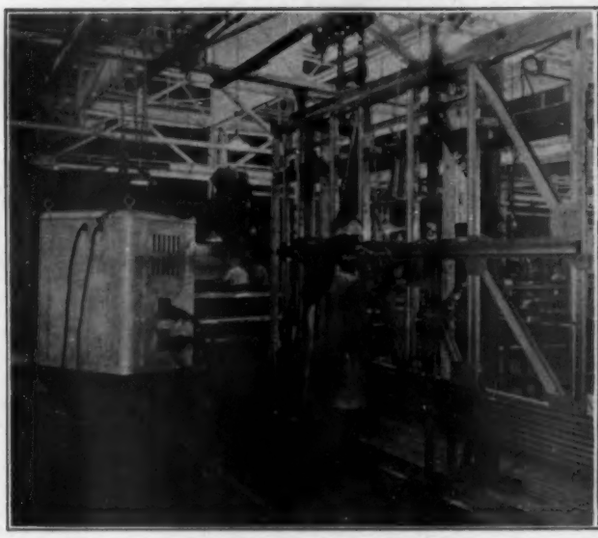
The wearing surface of the road consists of 1½ in. of asphalt plank.

Twenty Years With the Welding Industry

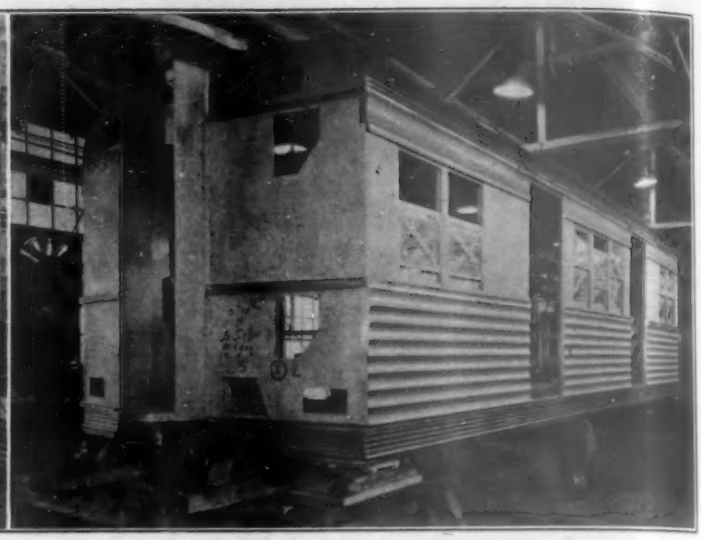
On July 1st, A. F. Davis, vice-president of The Lincoln Electric Co., Cleveland, Ohio, completed his 20th year of service in the welding industry. In these 20 years, he has seen arc welding develop from a last-resort method of fabrication and repair into a procedure that is now widely accepted as a safe and reliable method of joining metals.

When Mr. Davis joined the Lincoln company, he was sent to Chicago as a sales and service man. At arriving on the new job he was sent out to sell an electric welder to a certain concern who was said to be in the market for that kind of machine. Admitting that he knew nothing about arc welding, he was given a 4-page pamphlet to read, as it contained "all the information". The story is that he didn't make the sale .

That, however, didn't keep "Bob" Davis from rising to one of the most responsible positions in the industry. He returned to Cleveland as assistant to J. F. Lincoln, and step by step he went up in the organization, finally becoming vice-president of the company.



Side Frame Unit Being Assembled by the "Shot-Weld" Process of Resistance Welding.



One of the Stainless Steel Car Sections Nearing Completion. Each of These Sections Is Designed to Act Like a Structural Beam.

The Welded Car Enters the Local Transportation Field . . .

A 5-SECTION subway-elevated car, built of welded stainless steel and containing several engineering and mechanical innovations, has just been built by the Edward G. Budd Manufacturing Co., of Philadelphia, for the New York Rapid Transit Corp.

With its light weight, its novel power and braking systems, its rapid acceleration and quick deceleration, the new car is designed to speed up local service to almost express schedule without requiring reinforcement of the elevated structure. It has a seating capacity of 170 and a standing capacity of 470, or a total of 640 persons.

Since the car is of the articulated type —that is, adjacent ends of sections rest on a common truck—it performs as a single unit instead of as so many individual cars.

Light Weight, High Strength, and Not a Rivet

The car weighs only 250 lb. per passenger, or half as much as a comparable car of conventional design. The lightweight stainless steel was fabricated by the "Shot-weld" method, thin strips being welded into skeleton beams and other structural members, and these in turn being welded into sections so that each becomes virtually one piece of steel without a rivet in it. The result is a great reduction in weight without loss of strength.

With a 70-hp. motor driving each of the 12 axles, the anticipated acceleration is 5 miles per hour per second. Equally rapid deceleration is provided by eddy-current braking, which reduces the speed without the application of brake drums.

Not only were highly efficient sections used in the manufacture of this car, but these were placed to greatest advantage. The builders argued, for example, that a car supported on floor beams alone is an abuse of good material, since a car itself is really a beam and, in beams, the top tends to compress while the lower portion is in tension. Obviously, the greater the spacing between the top compression member and the lower tension member, the more easily is deflection resisted and less material will be required. What is simpler then than to use the roof for one member and the floor for the other? asked the designers. The result was a lighter and stronger car, built by a combination of efficient sections and superior materials, together with their effective placement.

Stainless Steel Used in Preference to Carbon Steel

Austenitic 18-8 stainless steel was considered as having advantages over carbon steel for this type of construction, since it resists corrosion, requires no paint, can be given a high tensile strength by cold rolling, without affecting its toughness, and can be fabricated and assembled by the "Shot-weld" process without impairing its metallurgy.

As used by the Budd company in car body construction, 18-8 is rolled into bright, shiny strips. The tensile strength specified is not less than 150,000 lb. per sq. in. These strips come in large coils and are then drawn through a series of rolls to form the required sections. Few exceed 0.050 in. in wall thickness, and some material is as thin as 0.010 in. The sections favor squared corners instead of rounds, for it is always easier to assemble squares. Flanged channels predominate, and these are later converted to closed sections by welding cover strips over the open face.

Fabrication and Assembly

The sections and methods of fabrication have been developed with a view to assembly by welding. The car structure follows a simple procedure whereby vertical or diagonal members dovetail between horizontal mouldings so that all eccentricity of loading is avoided. Attachment is usually by gusset plates, and is sufficient to develop the full strength of the member.

Final assembly follows upon a series of progressive sub-assemblies, starting with posts, floor beams and roof carlines. The first are then organized into shear panels and later built into the side frame assembly. Roof carlines form the skeleton for a roof assembly, while the floor beams drop into place at the time of attaching the roof to the side frames.

The end trusses complete the box. Stringers are then laid over the floor beams and four of these, two above and two below the beam, are trussed into a central compression buffing member. Above the stringers are laid corrugated flooring strips, welded to each other to form a continuous floor plate which ties into the sides and stringers.

Determining Gage and Structural Sections

Determination of gage and structural sections results from an elaborate stress analysis. In this, aircraft methods are largely used. Graphical determination of stresses is followed by a so-called Williot diagram which, in brief, parallels the stress diagram except that resulting deflections rather than loads are used. Rarely, however, is any structure which is complicated by doors and windows, graphically determinate throughout. Redundancy is inevitable. Its solution may be intricate, but the structure need not be.

As soon as a complete stress diagram is available, the choice of sections becomes a simple matter of proportioning cross-sectional area to load. No sections exceed 25,000 lb. per sq. in., which gives a factor of safety of six.

In the Budd type of construction, the side and deadlight panels do no structural work. All shear forces are taken by a distinct truss system. This departure from conventional practice results from an elaborate study of alternate methods. An incidental advantage lies in the fact that the outer sheathing will not show the highlights and shear lines which are seemingly inevitable in flat plate side walls. In this particular car, with its short length between supports and high loading per square foot of floor area, shear forces become a more serious factor than does bending, and the side framing assumes a correspondingly greater significance.

Here, the question naturally arises as to the ultimate importance of the effort and cost of light-weight construction. Thanks to it, the body structure of all five sections without trim or appointments has been reduced to some 40,000 lb., which, when compared to the car weight of 159,000 lb., is 25% of the whole. The percentage, however, remains about normal, since the urge toward elimination of needless weight has been extended into every department. A comparable train built according to convention would weigh at least 325,000 lb. Figuring then on a low estimate of 2c per pound per year, the difference in annual operating cost amounts to $3,200. Figuring on comparable acceleration, the increased motive power involves an initial outlay of some $30,000 more, with an interest on this investment of $1,500 per year. The sum of these two items alone represents a 5% interest on $94,000. Other economic advantages need not be advanced, nor is it necessary to justify the lighter equipment by emphasizing the fact that heavier cars accelerating and braking at the newer rates would probably involve reinforcing and higher maintenance of the elevated structure itself.

Welding Used in Truck Design

So far, the weight saving incident to the car body has been emphasized. Equally vital, though perhaps less spectacular, is that effected through a radical departure in truck design. Not only has the articulated car resulted in eliminating four trucks with a saving of some 44,000 lb., but the remaining six trucks have been materially reduced in weight. This has been accomplished through design and material. The frame and swinging bolster are both made up of plates of steel alloyed with chromium, manganese and silicon. These are electrically welded together into a structure which is carefully proportioned to the imposed loads and which is thoroughly annealed as a whole after completion of all welding operations. In this, care has been exercised to confine welding to places of low stress or pure shear. Toward this end, it has been necessary to cut the upper flanges of both side frames and both transoms out of a single plate. Nowhere is important welding done without there being a "build-up" from both sides of the web. A single side "build-up" is considered questionable practice. This steel when annealed has a tensile strength of 85,000 lb. per sq. in. The heaviest plate used is ¾ in., and the thinnest, ¼ in.

The New Five-Section Train of Stainless Steel.

Platform Wheel Stop Made of Weld Beads

Two parallel weld beads laid crosswise on a steel scale platform make an ideal wheel stop, says a recent issue of a *News Letter* of the National Safety Council. The beads should be about ¼ in. high and spaced according to the contact of the wheel, but not so snug that the vehicle could be moved off the platform only with difficulty.

Standards for Arc and Resistance Welders

Copies of the recently approved American Standards for Electric Arc Welding and Resistance Welding Apparatus (C52.1-1933 and C52.2-1933) are now available in printed form at 40 cents and 30 cents each, respectively, from The American Institute of Electrical Engineers, 33 West 39th St., New York, N. Y.

These standards cover the general conditions upon which acceptance tests are based for d.c. generators, motor-generator sets (including dynamotors), a.c. transformers and resistors used in arc welding, and transformers for resistance welding apparatus.

These standards were developed by a sectional committee under the joint sponsorship of the American Institute of Electrical Engineers and the National Electrical Manufacturers Association. They constitute a revision of former A. I. E. E. standards on the same subjects.

Draws Up Tentative Qualification Code

On June 21st, the Los Angeles Section of the American Welding Society held its last meeting before "knocking off" for the summer months. A large number of guests and members were in attendance.

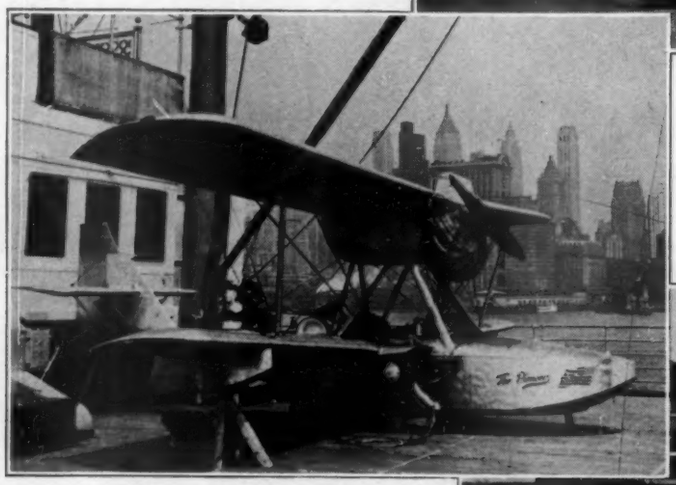
Two very interesting features marked the meeting, the first being a talk on "Welding as Applied to Railroad Boiler and Tank Construction," by O. H. Kurlfinke, of San Francisco, Chief Boiler Engineer for the Southern Pacific Railway, and the second being the presentation of a tentative welders' qualification code by Frank Howard, chairman of the committee who has been engaged for several weeks in drafting a code. Mr. Howard showed several screen slides illustrating test coupons and X-ray images of welds, parent metal, etc., used in connection with the proposed tests. It is hoped by the committee that the tentative code may be used at least as a nucleus, or aid materially, in the establishing of a permanent uniform national code for qualifying welders in all states.

The next meeting of the society will be held in October.

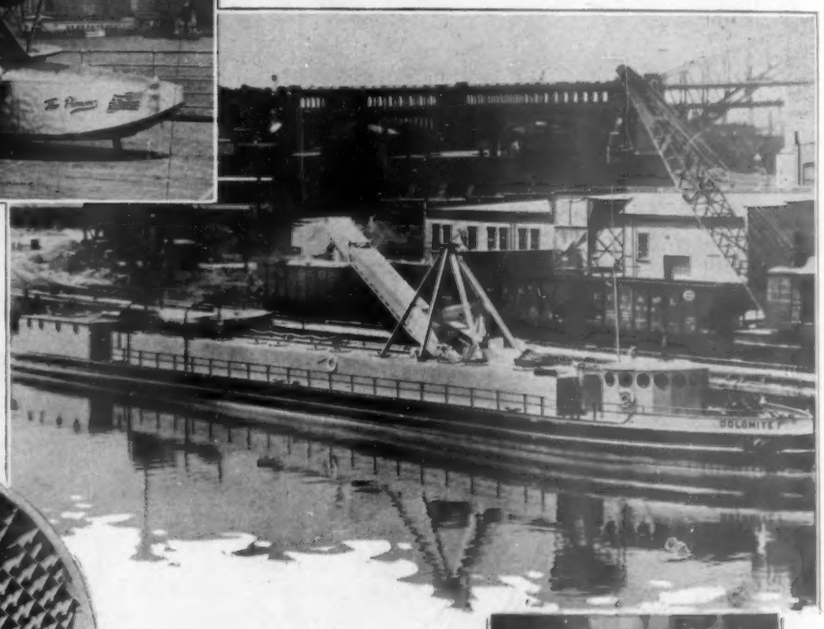
WELDING NEWS IN PICTURES

● The Reliable Welding Works, Olympia, Wash., have good reasons to be proud of this welded oil truck made in their shop.

● After two years of successful flying in Europe, this all-metal airplane, an American product, is returned to the United States. Built of stainless steel by the Budd "Shot-weld" process.



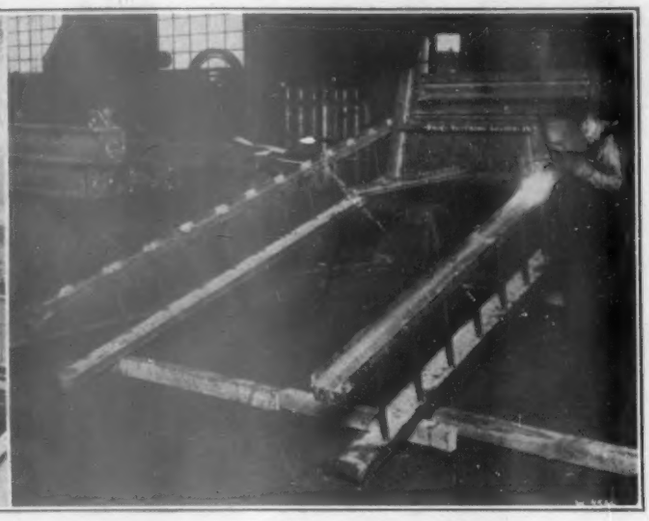
● The *Dolomite*, all-steel freighter, 214 ft. long, unloading a cargo of sulphur direct from boat to freight car. The vessel, as well as the unloading boom, is entirely arc welded. (Photograph courtesy The Lincoln Electric Co.)



● Welded 75-ton beet-pulp dryer, one of the largest ever built, dries the pulp from about 2000 tons of beats in 24 hours. The shell is welded from ½-in. steel plate. (Photograph courtesy the General Electric Co.)

● The fair sex have their inning! Mrs. Fred J. Cool, visitor at the recent welding show in Grand Rapids, is being given her first lesson in the welding of white metal, the instructor being R. H. Ogden, of the Aladdin Rod & Flux Mfg. Co.

New Observatory Dome, 62 Ft. in Diameter, Is a Combination Welded and Riveted Structure.



This All-Welded Stairway, Shown Under Construction, Is to Be Used in the New Observatory.

Welding in Observatory Dome and Building

The framework for a new observatory dome to house the world's second largest telescope started this month on a 1500-mile journey to the summit of Mt. Locke in southwestern Texas. The structure, fabricated and pre-assembled in Cleveland, with arc welding playing an important part, will be re-assembled near Fort Davis, 40 miles from the nearest railroad.

There on the mountain peak the structure will be rooted to the earth, protected against earthquake shocks by arc-welded steel bracing, and astronomers of the University of Chicago and the University of Texas, at an elevation of 7,000 ft., will begin new exploratoins of the solar system. Mt. Locke was chosen as the site of this new observatory because of unusually clear atmosphere with better observing conditions than perhaps any other location in the United States.

McDonald observatory, as it is to be called, was designed by the Warner & Swasey Co., Cleveland, Ohio, for the University of Texas. In it will be placed an 80-in. reflecting telescope, 25 ft. in length.

The dome of the observatory was erected in Cleveland by the Paterson-Leitch Co. under supervision of the Warner & Sawsey Co., designers. The dome is 62 ft. in diameter, with a height above the foundation of 73 ft. Construction of the dome required 125 tons of structural steel, and an equal tonnage will be used in the sub-structure. After the building has been erected on Mt. Locke, it will be covered with about 25 tons of galvanized iron sheets.

Floors of the structure are of the "battledeck" type, entirely arc welded for rigidity. The first floor of the supporting structure will be used for libraries and offices. The second floor will contain sleeping compartments, laboratories and photo-developing rooms.

Two main girders and a base ring constitute the main structural members of the dome, which is mounted on a plate-girder base fastened to the tops of the columns of the observatory building.

The main girders are 4 ft. 6 in. deep with $\frac{3}{8}$-in. web plates, 8x6x$\frac{1}{2}$-in. bottom-chord angles and 6x6x$\frac{3}{8}$-in. top-chord angles. The semi-spherical contour of the dome is formed by the shaping of auxiliary ribs which are fastened to the main girders and base ring. These auxiliary members are alternately 3-in. and 4-in. channels and split beams. Skirting hangars are of welded construction and are fastened to the auxiliary ribs.

Two 10-in. channels, reinforced by a 6-in. beam, form the bottom ring. These channels were joined with the flanges facing each other.

The supports for the conductor bars, the brackets, as well as the shield which prevents dirt from getting into the electrical conductors, are all of arc-welded construction.

An open space, 16 ft. wide, between the main girders extends from the base of the dome to a point 9 ft. beyond the peak. This opening is covered by two movable shutters. Although the shutters weigh 16 tons each, they are so balanced that they are quickly and smoothly opened or closed by a 2-hp. motor. Four movements of the dome mechanism are provided by push-button control within easy reach of the astronomer. The dome will revolve on twenty-six 30-in. wheels running on tracks mounted on the top girders of the sub-structure. The dome-turning mechanism is cable-driven by a 5-hp. motor.

Access to all parts of the dome and telescope is provided by an arc-welded electrically moved observing bridge running from the base to the top of the dome. This bridge is self-leveling, and arc-welded counterweights insure its smooth movement. A stairway built as an integral part of the dome gives access from the observer's floor to the bridge. Adjustable pulpits extend from the bridge and permit further adjustments of the telescope.

The two semi-circular elevating platforms, are welded on either side of the telescope pier, can be raised hydraulically 15 ft. above the observing floor. These platforms make it possible for the staff to make observations at lower points of the telescope tube.

Uniform temperature, necessary for greatest accuracy of observation, is assured by circulation of air between the inner and outer sheathing of the dome and sub-structure. Air enters at the foundation and passes up through louvres at the top of the dome.

To provide maximum protection against earth tremors, the earthquake bracing is to be entirely arc welded.

Welding of the structural work, trucks, counterweights, observing platform, stairways, doors and window frames, railings, flooring, earthquake bracings and other welded parts was done by the shielded-arc process, using "Fleetweld" electrodes and Lincoln welding generators.

Welding will also be employed in the construction of the 26 ft. telescope tube. Arc welding is said to surpass all other means of reducing deflection or sag in telescope-tube construction.

Opened Welding School in Youngstown

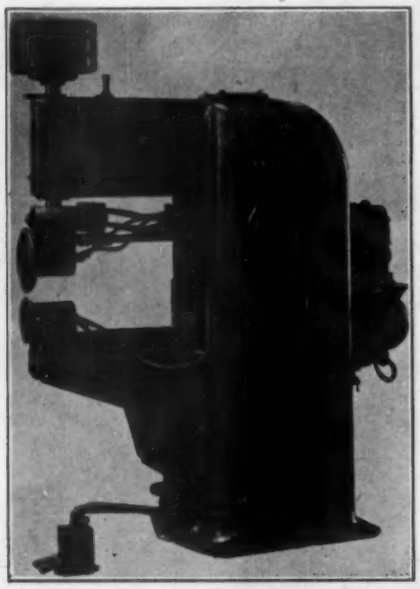
The Fisher School of Welding has been opened in Youngstown, Ohio, by C. Fisher and A. Zetzer. The school is located at Erie and Wayne Sts., on the second floor of the shop of the Liberty Welding Co., in which Mr. Zetzer is a partner. Equipment consists of an arc welder and light-duty oxyacetylene welding torches and accessories. At present, only a night course is offered, comprising 2 hours per night and 3 nights per week, during a total of 6 weeks. Thus the course consists of 36 hours, all devoted to actual welding practice.

New Equipment

Develops New Series of Seam Welders

A new group of seam welders, known as the "SW-100" Series Universal Type Air Operated Seam Welders, has been developed by The Taylor-Winfield Corp., Warren, Ohio. These new machines are said to extend the operating range and flexibility of welders of this type.

The welder illustrated is typical of the line, and is arranged so that the rolls



This Machine Can Weld From 45 to 130 In. of Seam per Minute.

can be turned either to the right or left of the knee for longitudinal as well as cross welding. The upper roll has a positive gear-reduction drive, with a variable-speed drive located between it and the motor, giving a welding speed range of from 45 to 130 in. per minute. The current is carried to the revolving spindles from the spindle bearings by a new type of construction, eliminating freezing, yet providing high conductivity and assuring smooth-running bearings without undue play, according to the manufacturer.

Pressure on the upper roll may be supplied by weights mounted directly on the head spindle, or by the same air cylinder that lifts the head, or by a combination of the two. An adjustable stop limits the opening of the upper head, permitting a vertical adjustment of from ¼ to 2 in. The lower roll support has a vertical adjustment of 4 in. to provide for wear on the welding rolls.

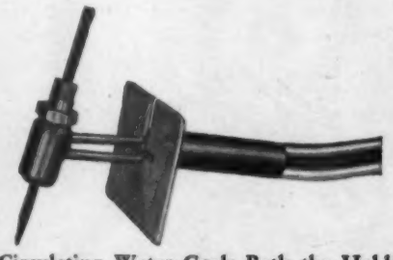
A transformer of 100-kva. capacity, of the pancake type, with water-cooled secondaries, is mounted inside the fabricated steel frame of the welder. Heat regulation is provided through an auto-coil, also mounted in the welder frame, with leads extending to a 16-step regulator, giving close adjustment of welding heats.

The head is raised and lowered by means of an air cylinder controlled by a 4-way foot-operated valve. A pressure-switch control prevents the current from being on before the pressure is built up on the rolls; also the current is cut off before the pressure is released. Current interruption may be provided through a synchronous-driven interrupter or thyratron control unit.

Carbon-Electrode Holder for Wide Range of Sizes

A new carbon holder for carbon-arc welding has been announced by The Hobart Brothers Co., Troy, Ohio. One of the chief advantages claimed for this holder is that it is designed for use with interchangeable tips, thus making it possible to use the same holder for a wide range of carbon sizes.

It is so designed that water circulates not only through the handle but also around the electrode itself, and it is said to be comfortable to the hand and highly efficient. It is said that even when the carbon electrode is used at a white heat for several hours, the holder itself will remain so cool that it can be touched with the bare hand at any point. It is perfectly balanced, with a comfortable grip and with a hand shield of asbestos



Circulating Water Cools Both the Holder and Electrode.

board, 5½ in. square, which can easily be removed for replacement with a larger shield, if desired. The entire holder is only 14 in. long and weighs only 2¼ lb.

This new holder was developed in connection with the "Long Arc" method of welding copper. There are many other carbon-arc welding applications, however, where this new accessory is ideal.

Etches Metal With Copper Electrode

The Annis Tool Etcher, shown in the illustration, is a portable electrical device for marking, numbering or lettering all kinds of steel or cast iron, whether soft or hard, and can be operated from any 110-volt a. c. lighting circuit. A stylus, or copper pencil, is provided for etching on metals, the copper tips being

Using the "Annis" Tool Etcher.

readily inserted in the stylus the same as leads in a mechanical pencil. These tips are made of No. 6 bare copper wire pointed on one end.

This device has two ranges of current —one for light and the other for heavy marking or lettering. It comes fully equipped, including cord and plug, and is manufactured by Robert B. Annis, Indianapolis, Ind.

"Fleetweld" General Purpose Electrode

"Fleetweld No. 7," a general purpose heavy-coated electrode for welding with the shielded arc on mild steel, has been announced by The Lincoln Electric Co., Cleveland, Ohio. Pronounced welding economies are claimed for the new electrode. It is designed particularly for high-speed and single-pass welding, and its arc characteristic is such as to make it particularly suitable for welds where fit-up is poor.

The new electrode is said to have a high burn-off rate and low spatter loss, providing exceptionally fast welding at low cost. The finished bead is smooth. Tests made on all-weld-metal specimens show a tensile strength of 70,000 to 80,000 lb. per sq. in., a yield point of 55,000 to 60,000 lb. per sq. in., and approximately 20% elongation in 2 in. The resistance to corrosion was shown to be greater than that of mild steel.

Fleetweld No. 7 is manufactured in diameters of ⅛, $\frac{5}{32}$, $\frac{3}{16}$, $\frac{7}{32}$, ¼, $\frac{5}{16}$ and ⅜ in. in 14 in. lengths, the three smallest diameters being intended for welding in flat, vertical, or overhead position, and the larger sizes for welding in

flat position only. The new electrode is packed in square metal containers holding 50 lb.

New "Manganal" Bars for Welding Manganese Steel

For the resurfacing and welding of broken and worn 11-14% manganese steel parts, and for the surfacing of carbon and alloy steel parts, the Stulz-Sickles Co., 91 New Jersey Railroad Ave., Newark, N. J., have developed what they term "Manganal Applicator (Filler) Bars," 11-13% nickel-manganese steel. These bars are of the same analysis as "Manganal" electrodes and are hot-rolled. While usually supplied in round form, these rods are also available in squares, flats, and special shapes, as well as in special forged wedges for building up worn 11-14% manganese steel shovel teeth.

Welding Helmet Has Features for Comfort

A new welding helmet, No. 650, developed by the Safety Engineering Bureau of the American Optical Co., Southbridge, Mass., is said to be particularly suited for work in confined spaces such as tanks, ship hulls, locomotive front ends, fire boxes, and other places of a similar nature.

Designed to fit closely to the face and

Showing Construction of New Helmet.

sides of the head without sacrificing ventilation or causing light leaks, the helmet is cool and comfortable under the most humid conditions. The bakelite welding-glass holder is outside the helmet and is fully dielectric. It assures the wearer of freedom from burns if accidental contact is made with the electrodes while working. The added distance from the face to the welding plate permits the helmet to be comfortably worn with a respirator and also helps to prevent fogging. Noviweld glass, which screens out more than 99½% of all injurious light rays, is standard equipment.

A swivel connection between the helmet and headgear provides three positive positions in which the helmet can be set when in use. Looseness, slipping and sideplay are eliminated, it is claimed. The entire unit is extremely light in weight and the balance between the headgear and the helmet increases the speed and positiveness with which the helmet can be set in position.

An illustrated folder has been prepared, describing the new helmet.

Trade Literature

"Hollup" welding wire, electrodes and rods are described in an attractive 51-page catalog recently issued by the Hollup Corp., 3333 West 48th Place, Chicago, Ill. Oscillograms are reproduced to show the steady performance of the Hollup "Protected Arc" welder with both bare and coated wire. Included are also electrode holders, protective equipment and clothing, welding cable, sandblast equipment, and various accessories. A large part of this booklet is devoted to valuable metallurgical and engineering data, design information, technique of welding the best known metals and alloys, and metallurgical tables.

A line of welding and cutting equipment has been added to their line of acetylene generators by The Sight Feed Generator Co., Richmond, Ind. A recent booklet describes the new "SF" equipment, including welding and cutting torches and outfits, regulators, outfits for plumbers and pipe welders, for carbon burning, and for lead burning, acetylene-air soldering and brazing outfit, manifolds, and other equipment.

A manual of welding and fabricating procedures for "IngAclad" stainless-clad steel has been issued by the Ingersoll Steel & Disc Co., 310 S. Michigan Ave., Chicago, Ill. In addition to welding, the booklet discusses soldering, riveting, drawing, sand blasting, shearing, punching, drilling, cold forming, pickling, and heat treating. Many products of various types made from stainless-clad steel are illustrated.

Safety heads containing rupture diaphragms for relieving excess pressure, are described in a booklet issued by Black, Sivalls & Bryson, Inc., Oklahoma City, Okla. These heads have a high discharge capacity and can be welded into separators or other oil-field equipment, or in pipe lines or vessels where additional discharge capacity is desired over that afforded by pressure relief valves.

Manganal 11-13% nickel-manganese steel electrodes, for welding and resurfacing worn and broken 11-14% manganese steel castings, are described in a folder entitled "Bare Facts," issued by the Stulz-Sickles Co., 91 New Jersey Railroad Ave., Newark, N. J.

A method to facilitate the erection of fixed-end beams welded to columns, which involves the use of field joints at the points of inflexion, is described and illustrated by diagrams in Plate 45 in the series of "Studies in Structural Arc Welding," issued by The Lincoln Electric Co., Cleveland, Ohio.

"Profitable Locomotive and Car Scrapping" is the title of a booklet recently published by the Air Reduction Sales Co., 60 East 42nd St., New York, N. Y., giving detailed data on methods and results as presented by the heads of railroad scrap and reclamation departments.

Electronic contactor timers, for use on spot welders and projection welders where accurate timing of the main-line contactor is desirable, are described in leaflet No. 20619, issued by the Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.

"Sight Feed" portable acetylene generators are described and costs of operation given in a pamphlet recently published by The Sight Feed Generator Co., Richmond, Ind. Included are also floodlights and flarelights. A table of specifications is given.

Properties imparted by molybdenum to steel and cast iron, are discussed in the first of a series of pamphlets entitled "The Moly Matrix" issued by the Climax Molybdenum Co., 295 Madison Ave., New York, N. Y.

A new welding supply catalog and price list, known as No. 201, has just been published by the Sutton-Garten Co., 401-415 Vermont St., Indianapolis, Ind.

Commercial News

Motion Picture Film on Arc-Welded Pipelines

A new educational motion picture portraying the construction of arc-welded oil and gas pipelines is offered gratis for showing, upon application to The Lincoln Electric Co., Cleveland, Ohio.

The new film, entitled "Shielded Arc Welding of Oil and Gas Lines," tells a graphic story of how pipelines are built, from the time the pipe arrives from the manufacturers, through each successive step until completion. Procedure of firing-line and bell-hole welding is shown in detail. Operations on recent pipeline projects were photographed in order to illustrate the most up-to-date methods of construction.

The picture is on 16-mm. film, and is suitable for showing to large or small audiences, in either offices or auditoriums. It is a purely technical film and has been received with great interest wherever shown. The time required for showing is approximately 12 minutes.

Steel Sales Opens Warehouse in Detroit

Warehouse space totaling 40,000 sq. ft. has been opened by the Steel Sales Corp. of Chicago, in the former Rickenbacker Motors plant at 4150 St. James St. in Detroit, Mich. Here will be kept a large stock of metals in sheets, plates and other forms, as well as welding wire for oxyacetylene, electric-arc and automatic arc welding.

The Detroit warehouse has complete facilities for shearing, rerolling, edging and straightening. Since the company was organized in March, 1915, their direct sales representation has been increased to 17 well-known mills.

F. W. Walters, vice-president and one of the founders of the company, is taking charge of the Detroit district, having been active there for about twenty years. The company is headed by J. A. Roesch, Jr.

Stanley A. Knisely, of Cleveland, has been appointed advertising and sales promotion manager of the Republic Steel Corp., with headquarters at Youngstown, Ohio. Mr. Knisely was formerly director of advertising research for the National Association of Flat Rolled Steel Manufacturers, and prior to that was with the National Paving Brick Association. He succeeds L. S. Hamaker, who was recently made vice-president and general manager of the Berger Mfg. Co., Republic subsidiary, of Canton, Ohio.

New distributors of products of the Republic Steel Corp., Youngstown, Ohio, are announced as follows: Railey & Milam, Inc., 27-39 W. Flagler St., Miami, Fla., Enduro Stainless Steel and Toncan Iron; Ohio Valley Hardware & Roofing Co., Evansville, Ohio, Toncan Iron; and Pidgeon-Thomas Iron Co., Iowa at S. Main St., Memphis, Tenn., Enduro Stainless Steel.

C. O. Epperson, president, Compressed Gases, Inc., 205 W. Wacker Drive, Chicago, Ill., announces the appointment of A. G. Scherrer as district manager of the New York Metropolitan area, with headquarters at 998 Thirty-ninth St., North Bergen, N. J.

Dr. Ancel St. John, of the St. John X-Ray Service, Inc., has accepted an invitation to head the Sub-committee on Radiographic Inspection, of the Boiler Code Committee of the American Society of Mechanical Engineers.

C. A. Macfie and C. C. Felton have been appointed vice-presidents of Revere Copper and Brass, Inc., with offices at the executive offices at 230 Park Ave., New York City. Mr. Felton was formerly sales manager of the Calumet & Hecla Consolidated Copper Co.

M. L. Eckman, of The Federal Machine & Welder Co., Warren, Ohio, has been spending several months in Europe, in the course of which he is promoting the interest and sale of "Federal" welders in Italy and France.

Frederick Salditt has been appointed export manager of the Harnischfeger Corp., Milwaukee, Wis. He has served many years with the company, part of the time in the engineering, sales and foreign departments.

C. W. Piper, 2033 Maple Ave., Norwood, Ohio, has been appointed sales representative for the southern Ohio and eastern Indiana territory by H. O. Swoboda, Inc., 4301 Main St., Pittsburgh, Pa.

Roy Thomas, of the Torch Shop, 1637 E. Vernon Ave., Los Angeles, Calif., has announced the recent sale of 100 of his "Craftmaster" torches to K. R. Wilson Co., for Ford garages.

Frank Lane, formerly with The Bastian-Blessing Co., is now connected with The Sight Feed Generator Co., Richmond, Ind.

Tube-Turns, Inc., have moved their New York office to 110 East 42nd St. The former address was 30 Church St.

Notes From the Field

The city of San Diego, Calif., benefited in more ways than one from activities of the CWA. By this agency, it acquired a new general repair and maintenance shop, which includes the housing of the city's welding and blacksmith shop. Up-to-date facilities and improved modern equipment make it one of the finest and most complete shops of its kind on the Pacific Coast. A down-draft system from all the forges in the blacksmith shop carries off the fumes and smoke directly from the fire, thus making for greater comfort and health for the workers. The building, built entirely by CWA labor, is 50 ft. wide by 80 ft. long and is of wood frame construction, covered with corrugated sheet metal.

In Its 40,000 Sq. Ft. of Space, the Detroit Warehouse Will Carry Large Stocks of Plates, Sheets, and Welding Wire.

Fred Dempsy and W. H. Sailing, until recently associated with the Cummings Welding Works, in Long Beach, Calif., have formed a partnership and opened a

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MELTING POINTS OF ANACONDA WELDING RODS

Material	Approximate Melting Point—Degrees	
	Cent.	Fahr.
Tobin Bronze	885	1625
Manganese Bronze	870	1598
Brazing Metal	930	1706
Naval Bronze	885	1625
Everdur	1019	1866
Phosphor Bronze A	1050	1922
Phosphor Bronze E	1070	1958
Phosphor Bronze D	1000	1830
Phosphor Bronze C	1025	1877
Silicon Copper	1083	1981
Deoxidized Copper	1083	1981
Electrolytic Copper	1083	1981
Nickel Silver	1055	1931
Ambrac	1150	2102

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ANACONDA WELDING RODS

job welding shop at 1902 Obispo Ave., in Long Beach. The shop will be operated under the name of the S. & D. Welding Works, the location being the same as that occupied some time ago by the Rex Welding Works. The partners recently completed the building of a neat, portable electric-welding unit for use in field work. The unit comprises a 300-ampere Lincoln generator driven by a 1927 Chevrolet motor and mounted on a 1925 Cadillac sedan cut down to suit the needs for transporting the unit.

A contract for constructing 16 fermenting tanks for a distillery has been received by E. D. Smith and Geo. Hauser, proprietors of the Electric Welding Co., 205 South 9th St., Louisville, Ky. These tanks will be circular with flat bottoms and open tops, and will be 12 ft. in diameter and 10 ft. high, and entirely arc welded. The bottoms will be ⅜-in. plate and the shells of ¼-in. plate. This concern recently completed a contract for the Frankfort Distilling Co., of Louisville, in which they arc-welded all steam headers, mains, and other piping in the boiler room. "Tube-Turns" and extra-heavy pipe were used throughout. After welding, the lines were tested at 300-lb. pressure.

Fire recently destroyed the job welding shop of Charles McNeal, on S. Arch St., Alliance, Ohio. Reports state that the fire started from the explosion of the gasoline tank of an arc welder, caused by building a preheating fire for a cylinder wheel too close to the welder.

The Seventh Annual Convention of the Iowa State Horseshoers' and Blacksmiths' Association was held on June 15th and 16th at Fort Dodge. In addition to the business program, there was an ample allotment of time for welding demonstrations.

J. ("Spider") Davis, until recently associated with the Welded Products Co., of Bell, Calif., recently opened a new job welding shop at 3605 Gage Ave., in Bell. The shop is being operated under the name of the Jayco Welding Co.

The job welding shops of Indianapolis, Ind., held a meeting on June 19th and were addressed by Dale George, president of The National Association of Welding Contractors, Inc.

W. Campbell, Comstock Park, Mich., has opened a job welding shop on Alpena Road, R. R. 1. Welding will be confined to the oxyacetylene process at present.

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Help Wanted—75c per line, minimum 4 lines. Jobs Wanted—4 lines free. Other Ads—$1.00 per line, minimum 4 lines
Count 8 words to line. Add 6 words for keyed address.

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For Sale—One 5-Operator G.E. 800-Amp. Welder, a.c.-motor drive. A-1 condition. Individual control panels, but can be coupled to give entire output through one panel. Also four 300-amp. Wilson portable welders and 6 Lincolns, for sale cheap. Service Co., 3732 Cedar Ave., Cleveland, O.

Bargains—Demonstrator Arc Welders. Gasoline, electric drive, belted, or coupled-together outfits. 30 days' trial. Easy terms, if desired. Write Ken's Welding Exchange, Box U-741, Troy, Ohio.

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First Class, All-Round Welder—20 years' experience in job, repair, production; pipe, bronze welding, alloy steels, nonferrous metals, machine cutting. Experienced supervisor, competent to conduct a department. Will work as welder. J. J. Cummings, 4246 Sheridan Road, Chicago, Ill.

WANTED TO BUY

Wanted—Small Arc Welder. Good condition and reasonable. Charles W. Dean, Russell Park, Ft. Myers, Florida.

Wanted—Job lot bargains in gauges, goggles, regulators, torches, hose, or anything pertaining to welder supplies. Torch Supply Shop, 1637 E. Vernon Ave., Los Angeles, Calif.

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